

**PUBLIC WORKS DEPARTMENT,
PUNJAB,**

IRRIGATION BRANCH.

**SUTLEJ DAM PROJECT,
1919.**

**VOLUME
I.**

REVIEW AND REPORT ON THE WHOLE PROJECT.



SUTLEJ DAM PROJECT.

VOLUME I.

CONTENTS.

PART I.

Review of the Reports and Estimates of the Sutlej Dam Project, by Mr. E. R. Foy, Superintending Engineer, Sirhind Canal Circle.

	PAGE.
Introduction	1
Summary—	
(a) Bhakra Dam	ib.
(b) Upper Sirhind	ib.
(c) Lower Sirhind	ib.
(d) Western Jumna Canal	2
Special Report—	
Full Supply Factor, Time Factor, etc.	ib.
Effects on canals below the junction of Sutlej and Beas ...	3
Linings and absorption	4
Linings and Contribution by Bikaner State	5
Seigniorage from Bikaner State	ib.
Programme of Construction	6
Establishment	ib.
Capital Cost	ib.
Financial Aspect	7
Report on famine conditions	ib.
Bhakra Dam	ib.
Physical Conditions—	
Capacity and area of Reservoir	8
Supply available	ib.
Filling the Reservoir	ib.
Magnitude and duration of floods	ib.
Afflux level likely to occur	ib.
Silt deposited in the Reservoir	9
Probable loss in the river from Bhakra to the regulating gauges	ib.
Sirhind Canal—	
Alignments	ib.
Main Line	ib.
Feeders	ib.
Patiala-Kaithal Feeder	10
Sirsa Branch Tail—Tohana Branch	ib.

Details of Works—		PAGE.
Upper Sirhind Canal—		
B.—Land	...	11
D.—Regulators	...	<i>ib.</i>
F.—River and Hill Torrents	...	<i>ib.</i>
G.—Bridges	...	<i>ib.</i>
H.—Escapes	...	<i>ib.</i>
J.—Mills	...	<i>ib.</i>
K.—Buildings	...	12
L.—Earthworks	...	<i>ib.</i>
L.—Lining	...	<i>ib.</i>
M.—Plantations	...	<i>ib.</i>
P.—Maintenance	...	<i>ib.</i>
Q.—Losses on Stock	...	<i>ib.</i>
1—3 Distributaries	...	<i>ib.</i>
1—4 Drainage and Protective Works	...	<i>ib.</i>
1—5 Special Tools and Plant	...	<i>ib.</i>
II.—Establishment	...	<i>ib.</i>
VII.—Interest charges	...	13
Programme of Work	...	<i>ib.</i>
Lower Sirhind Canal—		
Headworks—Location	...	<i>ib.</i>
Grey Canals	...	14
Abohar Branch alterations	...	<i>ib.</i>
Aliwal Headworks	...	<i>ib.</i>
Description of works	...	16
Report on Grey Canals	...	<i>ib.</i>
Western Jumna Canal	...	17
Appreciation	...	18

PART II.

General Report by Mr. H. W. Nicholson, Executive Engineer.

PARA.					
1.	Origin of the Project	...	...	...	19
2.	Surveys...	...	...	...	<i>ib.</i>
3.	Limits of the Scheme	...	...	...	21
4.	Available Supplies	...	...	...	22
5.	Areas commanded by the Project	...	...	...	23
6.	Probable area of irrigation	...	...	...	25
7.	Existing Irrigation and nature of crops	...	...	...	27
8.	Produce per acre and fair money value of nature to the chief crops	...	...	...	28
9.	Rainfall	...	...	...	<i>ib.</i>
10.	Subsoil water in the tract	...	...	...	29
11.	Famine tracts that will be protected	...	...	...	30
12.	Bhakra Dam	...	...	...	31
13.	Railways	...	...	...	32
14.	The New Sirhind Canals	...	...	...	33
15.	Upper Sirhind Canal	...	...	...	<i>ib.</i>
16.	Effects on canals below the junction of the Sutlej and the Beas	...	...	...	35
17.	Silt and Sediment	...	...	...	36
18.	Drainages...	...	...	...	37
19.	The Sarusti Canal	...	...	...	38
20.	Rangoi Canal	...	...	...	<i>ib.</i>

PARA.	PAGE.
21. Ghaggar Canals ...	38
22. Absorption ...	39
23. Lining ...	40
24. Lower Sirhind Canal ...	41
25. The Grey Canals ...	42
26. Bikaner's Contribution ...	43
27. Seigniorage from Bikaner ..	44
28. Financial aspect of irrigation in Bikaner ...	45
29. Sirhind Canal agreement with Phulkian States ..	46
30. Sirsa Branch agreement with Patiala State ..	46
31. Agreement with Bikaner State ...	47
32. Agreement with Jind State ...	46
33. Design of distributaries ...	46
34. Programme of construction ...	48
35. Working Expenses ...	46
36. Establishment ...	46
37. Capital cost of the Project ...	49
38. Financial aspect ...	52
39. Acknowledgment of services ...	46
40. Apologia ...	53

Statistical Statements.

1 Statement showing percentage of absorption on the existing Punjab Canals.	54
2 Statement showing area irrigated, Supply Duty, etc., at Distributary Head Gauges of Punjab Canals ...	55
3 Statement showing area irrigated, Supply Duty, etc., at Distributary Head Gauges of Western Jumna Canal ...	56
4 Statement showing area irrigated, Supply Duty, etc., at Distributary Head Gauges of British Branches of existing Sirhind Canal ...	57
5 Statement showing area irrigated, Supply Duty, etc., at Distributary Head Gauges of Upper Bari Doab Canal ...	58
6 Statement showing area irrigated, Supply Duty, etc., at Distributary Head Gauges of Lower Chenab Canal ...	59
7 Statement showing area irrigated, Supply Duty, etc., at Distributary Head Gauges of Lower Jhelum Canal ...	60
8 Statement showing area irrigated, Supply Duty, etc., at Canal Regulating Gauge of existing Sirhind Canal ...	61
9 Statement showing areas within irrigation limits (commanded area) of existing Sirhind Canal according to the Completion Report of the Canal ...	62
10 Statement showing Duty, Capacity Factor and Full Supply Factor of the existing Sirhind Canal system ...	63
11 Statement showing area irrigated, Supply Duty, etc., of Native States Branches at Head Gauge of 1st Feeder ...	64
12 Statement showing area irrigated, Supply Duty, etc., of British Branches at Head Gauge of Combined Branch ...	65
13 Statement showing area irrigated, Supply Duty, etc., of Abolish Branch at Distributary Head Gauges ...	66
14 Statement showing area irrigated, Supply Duty, etc., of Bhatinda Branch at Distributary Head Gauges ...	67
15 Statement showing the relation between the total area irrigated and the water utilized at sowing time measured at Canal Regulating Gauge, Sirhind Canal, British Branches ...	68
16 Statement showing the relation between the total area irrigated and the water utilized at sowing time measured at Canal Regulating Gauge, Western Jumna Canal ...	69
17 Statement showing the working of the existing Sirhind and Western Jumna Canals for the average of 3 years 1911-12 by sections according to which the changes will take place under the Sutlej Dam Project ...	70-71

PART III.

**Report on the physical description of the Tract between the Rivers Jumna
and Sutlej coming within the scope of the Sutlej Dam Project and the
History of the development of irrigation therein.**

PARA.		PAGE.
1	The limits of the tract	72
2	The Drainages	ib.
3	The tributaries of the Ghaggar on the right bank	ib.
4	The tributaries of the Ghaggar on its left bank	ib.
5	The Sarusti Nala	73
6	The Rakshi Nala	ib.
7	The Chautang in Bikaner	ib.
8	The Hakra	ib.
9	The Ferozeshah Canal	74
10	Western Jumna Canal	ib.
11	The Sirsa Branch	75
12	Extensions from the Western Jumna Canal prior to 1900	ib.
13	The Chautang Canal	ib.
14	The Markanda Canal	ib.
15	The Sarusti Canal	ib.
16	The Rangoi Canal	76
17	The Ghaggar Canals	ib.
18	The Chundigarh Canals from the Ghaggar	ib.
19	Patiala State irrigation from the Ghaggar	ib.
20	Mirza Koondee Canals from the Sutlej	ib.
21	Captain Baker's 1st Project for Sirhind Canal	77
22	Changes in the hill torrents	ib.
23	Canals from Tibra and the Ghaggar	ib.
24	The Bhutte area	ib.
25	Captain Dyas's 2nd Project for the Sirhind Canal	ib.
26	Captain Crofton's 3rd Project for Sirhind Canal	78
27	Government of India's orders on the 3rd Project for the Sirhind Canal	ib.
28	Final 4th Project for the Sirhind Canal	79
29	Construction of Sirhind Canal	ib.
30	Limits of irrigation from the Sirhind Canal	ib.
31	Grey Canals	ib.
32	Irrigation Commission	80
33	Insecurity of tract to be irrigated	ib.
34	Extensions from the Western Jumna Canal	ib.
35	Sarda-Ganges Larger Project	81
36	Sarda-Ganges Lesser Project	ib.
37	Action taken on the Sarda Ganges Project	ib.
38	Storage and Waterproofing	ib.
39	Kooh Dam Project	82
40	Extensions from the Sirhind Canal	ib.
41	Closed Drainage Tract	ib.
42	Sarusti Canal	ib.
43	Ferozepore Inundation Canals	ib.
44	Ghaggar Canals	ib.
45	Irrigation in Hissar from the Beas	ib.
46	Extension of irrigation in Sutlej Valley	83
47	Sir John Benton's opinion	ib.
48	Mr. Kennedy's opinion	ib.
49	Mr. Preston's opinion	ib.
50	Sir Louis Tupper's opinion	ib.
51	Review of the Local Government	84
52	Irrigation of the Rangoi Tract	ib.
53	The A-9 Rori Chantala Tract	ib.
54	Extension of irrigation south-west of the Sutlej Navi- gation Channel in Ferozepore and Faridkot	86
55	Irrigation in Maler Kotla	ib.
56	First proposal for Storage Reservoir on the Sutlej	ib.
57	Proposal for Storage Reservoir on the tributaries	ib.
58	Neila Dam Project	87
59	Origin of the present Project	ib.

PART IV.

Report on Famine Conditions.

PAGE.		PAGE.
1	Result claimed	88
2	Records referred to	<i>ib.</i>
3	Maps	<i>ib.</i>
4	Change in Government Policy	<i>ib.</i>
5	Mr. Fanshawe's views	89
6	Finance <i>versus</i> Statesmanship	<i>ib.</i>
7	Death of Cattle	<i>ib.</i>
8	Cost of famine relief in the past	90
9	Interval between famines	<i>ib.</i>
10	Maximum capital cost justified per acre irrigated	<i>ib.</i>
11	Hissar—the worst Famine District in the Punjab	<i>ib.</i>
12	Difficulty in getting reliable data on which to estimate	91
13	Tour through the tract	<i>ib.</i>
14	Water for drinking purposes	<i>ib.</i>
15	Native States	92

Appendix A-1.

Note by F. E. Gwyther, Esq., C.I.E., Chief Engineer, Irrigation Works, Punjab, dated 20th February 1915, on the proposal for a dam on the River Sutlej	93
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Appendix A-2.

Notes dated 4th and 6th March 1919 by H. W. M. Ives, Esq., Chief Engineer, and His Honour the Lieutenant-Governor of the Punjab, on the Closed Drainage Tract	96
--	----

Appendix B.

B-1 Extract from the report of the Indian Famine Commission, 1878-80	97
B-2 Extracts from Provincial Report on Famine in the Punjab, 1896-97	101
B-3 Extracts from District Reports of Famine in the Punjab, year 1896-97	108
B-4 Extracts from the report of the Indian Famine Commission, 1898...	105
B-5 Extracts from the evidence of witnesses from the Punjab taken before the Indian Famine Commission, year 1898	108
B-6 Extracts from the Punjab Famine Report, 1899-1900	109
B-7 Extracts from the Famine Report of Hissar District, 1899-1900	110
B-8 Extract from the report of the Indian Famine Commission, 1901	113
B-9 Statement showing losses of cattle in the Delhi Province, 1899-1900	114

Appendix C-1.

Note on the price of locally manufactured Portland cement which would make its general use possible	116
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Appendix C-2.

Details of concrete lining Franklin Canal, Rio Grande	122
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Appendix D.

Analysis of rate of Rs. 20 per hundred square feet for lining	123
--	-----

Appendix E.

Correspondence relating to water-rates	124
---	-----

Appendix F-1.

Agreement between Government and the States of Patiala, Jhind and Nabha regarding the Sirhind Canal	211
--	-----

Appendix F-2.

Final working agreement of the Sirhind Canal ...	215
--	-----

Appendix F-3.

Amended terms of agreement between Government and the State of Jhind for regulating the supply of water from the Western Jumna Canal ...	221
--	-----

Appendix F-4.

Draft agreement between Government and the Patiala State regarding the Sirsa Branch of the Western Jumna Canal ...	224
--	-----

Appendix G.**Maps and Diagrams.**

A. Map 1" = 16 miles showing Rainfall Isohyetals
B. " 1" = 16 miles showing Depth to Spring level ...	...
C. " 1" = 16 miles showing Subsoil Water Contours ...	...
D. Diagram showing results of absorption discharges on Sirhind Canal ...	...
E. " " capacity of Sirhind Canal Main Line at Garhi, mile 20	...
F. " " of Western Jumna Canal at Dadupur ...	...
G. " " area of various crops on Western Jumna Canal for Rabi and Kharif.	...
H. Diagram showing area of various crops on Sirhind Canal, British and Native State Branches, for Kharif.	...
I. Diagram showing area of various crops on Sirhind Canal, British Branches, for Rabi.	...
J. Diagram showing area of various crops on Sirhind Canal, Native State Branches, for Rabi.	...
K. Diagram showing area of various crops on Ghaggar Inundation Canals for Kharif and Rabi.	...
L. Diagram showing the price of wheat per maund in Hissar District and equivalent weight of produce taken by the water-rate on the Western Jumna Canal.	...
M. Diagram showing the price of gram per maund in Hissar District and equivalent weight of produce taken by the water-rate on the Western Jumna Canal.	...
N. Diagram showing the price of cotton per maund in Hissar District and equivalent weight of produce taken by the water-rate on the Western Jumna Canal.	...
O. Diagram showing the price of <i>gur</i> per maund in Hissar District and equivalent weight of produce taken by the water-rate on the Western Jumna Canal.	...
P. Diagram showing the price of rice per maund in Hissar District and equivalent weight of produce taken by the water-rate on the Western Jumna Canal.	...
Q. Diagram showing the price of wheat per maund in Ferozepore District and equivalent weight of produce taken by the water-rate on the Sirhind Canal.	...
R. Diagram showing the price of gram per maund in Ferozepore District and equivalent weight of produce taken by the water-rate on the Sirhind Canal.	...
S. Diagram showing the price of cotton per maund in Ferozepore District and equivalent weight of produce taken by the water-rate on the Sirhind Canal.	...
T. Diagram showing the price of <i>gur</i> per maund in Ferozepore District and equivalent weight of produce taken by the water-rate on the Sirhind Canal.	...
U. Diagram showing the price of maize per maund in Ferozepore District and equivalent weight of produce taken by the water-rate on the Sirhind Canal.	...
V. Diagram showing the price of rice per maund in Ferozepore District and equivalent weight of produce taken by the water-rate on the Sirhind Canal.	...
W. Diagram showing hydrographs of Sutlej and Beas, May 16 October 1918.	...
Map I, showing Famine Affected Area 1896-97.	...
Map II, ditto Kharif 1895.	...
Map III, ditto Rabi 1896.	...
Map IV, ditto Kharif 1896.	...
Map V, ditto Rabi 1897.	...
Map VI, ditto 1899-1900.	...

Referred to in
Part IV.

SUTLEJ DAM PROJECT.

PART I.

REVIEW OF THE REPORTS AND ESTIMATES OF THE SUTLEJ DAM PROJECT, BY Mr. E. R. FOY, SUPERINTENDING ENGINEER, SIRHIND CANAL CIRCLE.

It is difficult in a work of such magnitude involving three large schemes and one small one to keep the written matter within reasonable bounds.

In this review only the most important points in the various reports will be touched on where further amplification is needed. The General Report by Mr. Nicholson and this review should give most people a full idea of the whole scheme, references to the other reports only being necessary when further technical and other details are required.

In no place in the other reports are the details of the Project (that is the works required for the whole scheme) condensed into one paragraph. It is as well therefore to say here that the estimates now submitted provide funds to cover the probable cost of the four big works : —

- (a) Bhakra Dam,
- (b) Upper Sirhind Canal,
- (c) Lower Sirhind Canal, and
- (d) The Western Jumna Canal Extensions, a comparatively small but important item.

(a) *The Bhakra Dam* will be built across the Sutlej River in a gorge about 40 miles above Rupar. It will be 395 feet high from foundation level to roadway and will impound 2,583,550 feet acres of water at ordinary level and 2,763,000 feet acres at emergency level 10 feet higher. This reservoir stores the water which makes the rest of the scheme feasible. The average daily draw off it is estimated will be 6,175 cusecs, of which after allowing for losses *en route* 5,468 will be available in the canals for 21 days.

(b) *The Upper Sirhind Canal* will consist of :—

- (i) The present Rupar Headworks enlarged and remodelled to pass another 2,000 cusecs into the canal, *i.e.*, 10,500 instead of 8,500.
- (ii) The existing Main Line Sirhind Canal with banks raised where necessary to pass another 2,000 cusecs.
- (iii) A new Feeder to Patiala to carry 8,644 cusecs, more than double the capacity of the present channels, but running parallel to them. Beyond Patiala this channel will be taken across the Closed Drainage Tract, bifurcate into the Tohana Branch and Sirsa Branch Feeder, the latter linking up with the Sirsa Branch of the Western Jumna Canal above Ohandana.
- (iv) The existing Abohar Branch down to mile 43 and Bhatinda Branch down to mile 58 of the present Sirhind series will be practically abandoned as the greater part of their irrigation will be absorbed into the new Lower Sirhind Canal, the upper distributaries of the Abohar Branch being fed by a Feeder Distributary concrete lined. The present Bhatinda Branch will only carry a much reduced supply as far as the head of the Bhadoor Distributary at about mile 45, the existing channel being allowed to berm up and contract. These two reductions benefit in saving 337 cusecs in absorption losses.

Lower Sirhind Canal will consist of :—

New Headworks at Aliwal on the usual lines (though differing in details) of a weir, undersluices and Canal Head Regulator, with suitable Protective and Training Works.

The Canal itself, which will carry 9,259 cusecs, will run straight across country in a south-east direction intersecting the existing

Abohar Branch below Daudhar Fall and the present Bhatinda Branch at Dhipali, and so on straight to the famine tract of Hissar District in Sirsa Tehsil known in our records as A-9. At Phul, 5 miles from Dhipali, the Bhatinda-Bikaner Feeder will take off, carrying 2,307 cusecs into the deserts of Bikaner.

(d) *The Western Jumna Canal.* By reason of the Sirsa Branch below Mundri Irrigation Rest-House, mile 34, becoming a part of the Upper Sirhind Canal, 1,250 cusecs become available for use in the Western Jumna Canal for extensions in the Tosham, Pai-Rohana and Beri-Balaut tracts and for increases of intensity in other parts. The money provided is to cover the cost of the new distributaries and alterations to existing channels.

The total new irrigation anticipated with full supply factor of 212.5 will be 2,120,342 acres.

Reference Executive Engineer's General Report, Vol. I, Part II.

Paragraph 6.—Full Supply Factor—Time Factor, etc.—The Executive Engineer has given definitions of various terms used. He differentiates between "time factor" and a new term introduced "capacity factor". I am not prepared to accept this as it defines "time factor" purely as a ratio of time but which is of no particular value, whereas what he now calls "capacity factor" is what is understood by the older generation of irrigation officers as "time factor". No doubt he may be right purely as accuracy of definition but it produces redundancy and is liable to lead to confusion.

The proposals for draw off from the Reservoir are based on a time factor (now called capacity factor) of 0.6—*vide* Vol. II, paragraph 3, page 4. The Executive Engineer now shows this to be 0.52 and argues that this means a great increase of supply available. This is hopeful and shows that our proposals are not unduly optimistic and that we are not counting on the last few cusecs for our results. On the other hand, it is safer to fix on 0.6 because we are going to drier lands where the demand will be keener, and the figures of the existing Sirhind cannot be accepted as an infallible guide. The low time factor of the Sirhind in the Kharif is due to considerable assistance from the monsoon in most years and to the comparative unpopularity of Kharif irrigation as compared with Rabi. The Rabi time factor is low, due to the low supplies in the river. As the new irrigation will be in drier tracts not so favoured by rainfall in the monsoon, we may expect a keener demand in the Kharif and the use of stored water in the Rabi will enable better supplies to be run when needed. It would not be safe therefore to count on the advantage expected.

The distributaries are designed on a full supply factor of 170 to keep on the same basis as the present channels but we know they will do more irrigation. That is, the channels are larger than they need be for the irrigation expected from them. This is on a par with past practice in another form. On the Upper Swat River Canal for instance the channels were designed for a certain discharge and then 25 per cent. was added for emergent supplies at times of keen demand. So the channels were made larger than they need have been and we are doing the same here knowing it will result in more irrigation. Therefore we are justified in counting on an additional 25 per cent. of irrigation, and basing our revenue returns on this assumption—

The existing Sirhind Canal system
F. S. F. actually gives in practice from
214 to 260.

(Sd.) H W IVES—17-5-19.

Firstly, by experience from the channels of the present Sirhind Canal.

Secondly, by having stored water in the Rabi to use exactly at the time when it gives best results.

A small example will illustrate this second advantage. The Rabi area depends on sowing which can be done say in October and November. Suppose we had a reservoir now and could count on being able to run the Sirhind Canal full bore for 61 days; and allowing 2.25 acres irrigated per day per cusec entering the canal, the area of Rabi the existing Sirhind could put down would be—

$$3,500 \times 2.25 \times 60 = 1,147,500$$

not taking into account barani areas which could be picked up later if winter rains held off.

Allowing 100,000 acres of this are Kharif waterings taken for maturing in early October, the net result is 1,017,500 acres of new Rabi which can be assured annually against 886,984 acres, the present average of the Sirhind Canal, based on the figures for the 5 years ending 1916-17.

Not entirely. The ordinary supply passing down the River would, however, have to pass on, in order not to interfere with the expectations held out for the Sutlej Valley Project.

(Sd.) H. W. Fox—17-5-19.

This is a supposition only of what can be done.

(Sd.) E. R. Fox—18-10-19.

No expectation can be held out to the Sutlej Valley Project of water of the Sutlej after supply falls below 8,500 F. S. capacity of present Sirhind.

(Sd.) E. R. Fox—18-10-19.

The reservoir could then be closed down
for a month or six weeks and the reservoir

supply partially replenished by the inflow from

above and then reopened for "Kor" and final waterings.

It is clear therefore how a controlled supply from a reservoir will improve the Rabi full supply factor and there is ample justification for using 212.5 per cusec at distributary heads with which to compute the area of irrigation expected.

Paragraph 16.—Effects on canals below the junction of Sutlej and Beas.—From the considerations discussed by Mr. Nicholson two important questions arise—

- (i) Are the Beas supplies alone sufficient for the Sutlej Valley Canals above the two Weirs at Gandasinghwala and Jamlera during August when the reservoir is filling?
- (ii) In September in falling rivers are the combined supplies of the Sutlej and Beas sufficient for the demands of all the canals at Rupar, Aliwal, Gandasinghwala and Jamlera?

There is little or no difficulty in answering the first in the affirmative.

It is reasonable to suppose that the summer supply of each river must bear some relation to its own winter supplies and we then have the following :—

The average daily December and January supplies in the Sutlej	
at Rupar for 11 years 1903-04 to 1913-14 were	4,619
Ditto for Beas at Naushera	4,115

That is the Beas average is 89 per cent. of the Sutlej.

Now between 15th July and 31st August the Sutlej has seldom carried less than 40,000 at Bhakra, and when it has, it has only been for very short periods in some years and then never less than 30,000. If there is any relation between winter and summer discharges then the discharge of the Beas may safely be assumed to be about 89 per cent. Sutlej supply in that period and would generally be about 36,000, falling occasionally to 27,000, which is all that is required for the Sutlej Valley Canals and which would therefore need no assistance from the Sutlej. The above was written before the phenomenally low year of 1918. The figures of August 1918 based on actual observations show that in the worst year on record the supply in the Beas fell below the minima (27,000) above estimated on only five days in the whole month.

Take it another way. We are able to store 2½ million feet acres in the Sutlej in August in addition to letting a very large supply go down below. Allowing the same draw off from the Beas and accepting that the Beas supply is 89 per cent. of the Sutlej and we would have on an average 2,225,000 foot acres available in August on the Beas. This works out to 30,000 cusecs per day. This, however, deals with averages, considering minima per day only.

Fortunately we have the abnormally low figures of 1918. These figures are the lowest on record in our ten years of observation at Bhakra, and from

the rainfall probably the lowest on record for 50 years as far as we can judge from data at Rupar. These show us the river was less than 20,000 only two days in the month and under 25,000 only 3 days.

In normal years these minima would not occur and we cannot allow a deficiency of 5 days in the month one year in fifty or even one year in ten to wreck or even modify the proposals made for the Bhakra Dam.

Regarding the second question, the first point to settle is:—What are the claims of the canals below?

We know their designed full supply requirements and we hope to give them this in most years in fact that is our aim. But the point remains that 75 per cent. of the 27,000 cusecs required at Gandasinghwala and Jamlara is for what are now inundation canals and will remain Kharif channels. These canals have always had a precarious supply in September; silted beds and a falling river mean they dry up early in September as a rule though a few may occasionally for a series of years even carry a small winter supply. But the important fact remains that even a precarious supply in September is not assured to them at present, therefore for the future they cannot demand or establish a claim to full supply all through September. They can only ask to share on equal terms with others the total water available in the combined rivers up to 1st October. If this condition be fully laid down by competent authority as an axiom for the working of all the combined canals of the Bhakra and Sutlej Valley Schemes we can proceed to examine the possible shortage.

On averages there will never be shortage before 20th September.

Considering individual years we can be certain of full supply for all canals practically in all years up to 15th September (except 1918, which was abnormally low, and will occur once in 50 years).

In good years it will be sufficient up to 20th September, but after that date there will be a shortage in most years amounting by the end of the month to an average of 13,000 cusecs, or 29 per cent. of the total designed full supply requirements.

If it is accepted that up to 30th September preference should be given to Kharif channels, which will have little or no claim to water after that date, it will not be difficult to make good an average deficiency of 13,000 cusecs by rotational workings and by taking it from the perennial channels of the new series which will get ample water after 1st October in time for Rabi sowings. It must always be borne in mind that the existing Sirhind has an established claim up to 8,500 cusecs on all supplies in the Sutlej at any time, and that no stored water can be given to the Gandasinghwala and Jamlara Canals except as an act of grace when there is a surplus in the reservoir which cannot be utilized.

We, therefore, need not let the bogie of insufficient supplies in August and September interfere with the proposals for the Bhakra Dam and Reservoir.

Paragraphs 22 and 23.—Linings and absorption.—This project introduces

"Lining" has been done on the Lower Chenab Canal with good results wherever attempted. But there are great difficulties in doing any lining on a running canal on account of want of opportunities of closures. Lining, which is so beneficial in conserving water and preventing water-logging, can best be done in the initial stages of construction of a canal.

into the Punjab and probably into India "lined"

channels, so ordinary a feature in America but

not tried here except in one or two small in-

significant channels. The necessity is twofold:—

Sd/- W. J. V. 17-3-19.

Firstly, because both the Upper and Lower Sirhind Canals go across the natural drainages of the country and it is essential that we should not add to water-logging conditions by putting a bar of percolation water from the beds of the channels running across to act as a weir to hold up the subsoil flow underneath.

Secondly, at great expense we propose to store water at a cost of 4 crores of rupees, and we cannot afford to let this valuable water be wasted by going into the soil. The percolation losses saved enable us to spread the irrigation over a larger area with very satisfactory financial results.

The Executive Engineer estimates a total saving of 1,783 cusecs, which, with a full supply factor of 212.5, enable us to do 365,787 acres of irrigation, bringing in a net annual revenue of Rs. 18,28,935, which again justifies the expenditure of Rs. 3,65,78,700 at 5 per cent.

i.e., at Rs. 5 per annum,
Total direct and indirect 6 per annum
Working Expenses 1 " "
Net 5 " "

But Mr. Nicholson shows that the difference in cost between lined channels and larger but unlined channels for the same discharges would have been 1.3 lakhs to the disadvantage of the former, whereas as shown immediately above 365.75 lakhs would be justifiable. The actual gain in lined channels is therefore enormous.

We know nothing in this country about the most efficient way of carrying out these linings, and it will be necessary to depute more than one officer to America to study the best methods, and on their return to teach their *confrères* and Assistants.

Might be done by officers proceeding on long leave.

(Sd.) H. W. Ives—17-5-19.

In the absence of sufficient cement being procurable in India, white lime and Surkhi or Kankar lime mortar will have to be used. It is taken that 6" thick concrete will suffice and the rate is worked out thus :—

		Rs.
Price of ordinary concrete as per schedule	...	30
Add extra for breaking smaller stones	...	2.25
Additional for 50 per cent. extra mortar	...	3.2
Add for extra labour in finishing surface and excavation of 50 c.ft. of earth per 100 s.ft. of concrete	...	4.6
Total	...	39.95, say
		40 per cent. c.ft.
		or 20 per cent. s.ft. 6" thick.

Contribution from Bikaner State.—Executive Engineer has given figures showing what the sums are Bikaner State must be prepared to face. The cost is probably considerably higher than usual in irrigation schemes but at the same time conditions are unusual. Expensive stored water is the only medium for irrigation of the desert lands on the south, and again expensive lined concrete channels are needed to make the most of this expensively stored water and prevent it being wasted on the way in absorption in earthen channels. We expect to save 75 per cent. of the ordinary wastage from this cause—the total saving in the lined and unlined channels of the whole scheme being 1,783 cusecs. On the other hand the State will receive apart from the direct benefits of 477,500 acres of irrigation the following indirect benefits :—

The ordinary loss in absorption is 8 cusecs per million square feet of wetted area. By lining we will save 6 out of every 8 cusecs.

(Sd.) H. W. Ives—17-5-19.

- Immediate cash returns from sale of State lands.
- Increase of trade and general prosperity and thereby increase of customs dues.
- Increased capacity of the people to higher taxation as their share of the increased prosperity.

To a far-sighted and enlightened Ruler like His Highness the Maharaja of Bikaner these considerations will probably be self-evident and the money to be sunk in canals will probably be a small item compared with the resulting benefits to his State.

Paragraph 27.—Seigniorage from Bikaner State.—As Bikaner State will pay for its own canals and draw into its own exchequer the revenue derived from irrigation, it will be necessary to levy from that State a seigniorage for

the use of water the property of the Supreme Government. This should be fixed as noted on by the Executive Engineer in his report as a percentage of the average water-rate. It should not be fluctuating but during, say the first five years after water is let into State channels while irrigation is developing, this seigniorage might be half of what it will be ultimately.

Paragraph 34.—Programme of Construction.—With a work of this magnitude it is essential that—

- (a) Some revenue should come in at the first possible occasion.
- (b) The period of construction should be as short as possible. The saving in one year's interest charges alone would justify urgent and expensive measures working against time to finish even one year earlier than a quick and easy-going programme would let us in for.

The programme of each link is separately discussed in each volume. It is necessary to co-ordinate the whole in explanation of the proposals.

As there is a certain amount of water surplus in the Sutlej during the Kharif we can take it into the British Branches even without any stored water and give it to the Sirsa Tahsil (A-9 tract) in the 4th or 5th year for Kharif irrigation only. Therefore the Bhatinda-Phul-Rohri Feeders will be undertaken in the first year together with the inception of the Dam itself. At the end of the 5th working season the Dam will be up to 1,300 R. L. and a certain amount of stored water will be available. Simultaneously with this water becoming available the Abohar-Bhatinda Feeder will also be finished and it will be possible to give Rabi waterings to the A-9 tract by rotational turns in the Abohar Branch or Bhatinda Branch. By the end of the 7th working year the Dam should be up to the full height and the completion of the Aliwal Headworks and Main Line must synchronize with it so as to make the best use of the stored water. The Bikaner Irrigation Channels will be ready about the 9th year.

Simultaneously with the completion of the Dam and Aliwal Headworks the upper reaches of Patiala-Kaithal Feeder should be ready with some distributaries, and even if the Manpore-Patiala Feeder is not ready some water could be taken down in the existing feeders in rotational turns by agreement with the States.

However, the fact remains that while the Dam will be finished in the 7th year, the whole scheme will take 12, so that for the last 5 years and up to the development of irrigation there will be surplus water in the reservoir. This can earn most valuable revenue by being given to increase sowings on the existing Sirhind Canal and its branches and in assisting the Ganda-singhwala Canals if required.

Paragraph 36.—Establishment.—The details of officers required and the cost are referred to elsewhere. My only reason for mentioning it again is to draw attention to the very large staff which will be required to officer the new Divisions and Sub-Divisions. If there is any prospect of this gigantic scheme being sanctioned in the course of the next two or three years it is essential and indispensable that Government should look ahead and get its young officers now at once so that they can be trained and be able by the time work starts to take their places as efficient officers either on the new canals or to take the place of men from existing canals. This is a most important matter and I urge its consideration on Government.

Paragraph 37.—Capital Cost.—The total cost of the Project including all direct and indirect charges works out as follows:—

	Rs.
Bakra Dam	3,98,74,490
Upper Sirhind	4,18,27,300
Lower Sirhind	5,92,47,297
Western Jumna Canal	39,25,839
Total	14,44,74,926

exclusive of simple interest during construction.

The rate has not been settled finally yet, but if 5 per cent. be taken these interest charges total at the end of the 12th year to Rs. 5,05,99,158, making a grand total of Rs. 19,50,74,052, but in the meanwhile a revenue of Rs. 2,34,17,814 will have been earned.

Paragraph 38.—Financial Aspect.—It is impossible to forecast this without final orders on :—

- (a) Rate of interest at which borrowed money must be arranged for.
- (b) The revenue returns as " water-rates " which may be accepted.

Different alternatives have been worked out and submitted to the Chief Engineer with this office No. 2071-D., dated 10th April 1919, and a further note added in the Secretariat file on 4th May 1919. If these questions are decided as suggested we expect the scheme to be remunerative, giving a return of 6½ per cent. even at 5½ per cent. interest if a 212·5 Full Supply Factor be taken and the rates proposed in the letter quoted be accepted. This takes no credit for value of State lands in Bikaner which will probably be sold and should form a credit to the Project even though the money does not come into the coffers of the British Government. It is an indirect return to the scheme ; whether to one State or the other is immaterial.

Reference Vol. I, Appendix B., Report on Famine Conditions.

In this Report is collected together much information about the famine tracts of India with special reference to the unenviable position occupied by the Sirsa Tahsil of Hissar District as one of the worst tracts in India. Eminent authorities are quoted at length and lengthy excerpts are made from published Reports of Famines and findings of various Commissions. The whole is illustrated by excellent maps.

The object of this voluminous documentary evidence is to show the absolute necessity for providing irrigation for this tract. The necessity is so acute that mere financial considerations alone should not retard the acceptance of the Bhakra Dam Scheme. It is anticipated that the scheme as a whole will pay, but even if it did not the protection from famine to so large a tract should outweigh mere financial considerations. The evidence collected speaks for itself and it is unnecessary for this review to do more than draw attention to it.

Other schemes, e.g., the Thal, may give promise of better financial results, but water will there be carried chiefly to largely unpopulated regions and settlers will have to be brought in. Here, on the other hand, is an inhabited region covered with old established villages. Surely it is better for the greatest benefit to the many to protect these villages and their people from famine than to colonize a new tract. If money and means are available for both to be taken in hand simultaneously well and good, but if not the settled tract should have preference.

Reference Vol. II, Bhakra Dam.

The contents of Parts I and III have been either entirely written by me or compiled under my direction. There is therefore nothing to add to what is included in them.

Part I—Is the Engineering Report.

Part II—On " Physical Conditions " has been written and compiled by Mr. Nicholson and reviewed by me separately.

Part III—Contains the Estimates.

Part IV—Refers to the Bhakra-Nalagarh Railway.

Part V—Contains masses of figures and results of silt experiments carried out in 1916 at Rupar and Bhakra simultaneously, on which the Executive Engineer has based his deduction, and conclusions on the life of the reservoir.

Reference Vol. II, Part II, Physical Conditions.

Capacity and Area of Reservoir.—The capacity of the reservoir when full has been computed by two methods, as described by Mr. Nicholson and from the actual Cross Sections of the valley taken by R. B. Baij Nath's Surveyors in 1909-10. The results agree very well and it may be assumed that the volume of water available on which the irrigation of the whole scheme is based is accurate enough for all practical purposes.

Supply available.—Our records for Bhakra go back to 1909-10 which covers a large number of varying seasons, and the daily discharges are all plotted on diagrams bound up in this volume. These all show the large surpluses in the river from June to August. The suitability of the gorge as a gauging site is indicated by the absence of variations in discharges in these ten years.

Filling the Reservoir.—The Executive Engineer has worked out very careful calculations of storage possible in each year beginning at different dates. On the same statements are also shown the silt volume which it is estimated will be deposited in the reservoir in different periods. To prevent deterioration of the reservoir it is desirable to postpone the filling as late in the year as possible to reduce the amount of this deposited silt.

1st August will probably be the latest safe date on which to begin storing. 1918 was the only year when the reservoir would not have filled from that date, but the year was exceptional and a similar low river may not occur again for 50 years.

The shortage was only 1/5th and if such a year should occur again we would have to be content with 1/5th less irrigation in that winter. This is not alarming. I think we may therefore lay down that the 1st August may be taken as the date for closing sluice gates and beginning to store water.

Magnitude and Duration of Floods.—From special investigations made in 1917 it appears that the 1894 flood is the highest on record. In October 1915 when I first visited Bhakra the villagers showed me what they said was the highest point ever reached by a flood and this was near the roots of a Banyan tree below the village. It is satisfactory to find that an independent observer two years later found the same spot, and when plotted this point comes on the Longitudinal Section of High Flood level of the 1894 flood.

The villagers informed me that it remained at this high level quite a short time, only an hour or two, and subsided very quickly. The peaks of these high floods in hilly tracts are very marked, but also of very short duration.

This high flood at Bhakra corresponds to a very high flood at Rupar on 16th July 1894.

Reference is made to a still higher flood in 1876 about which no reliable data are available. It is said, however, that this was due to a landslide which blocked the river and then burst. Such an occurrence in future need cause no alarm. If a landslide occurred again higher up we would have warning through our telegraph system and we could then lower the ponded up level in the reservoir in anticipation of the burst when it came. The extra volume such flood brought down would then be absorbed in the reservoir.

The provision therefore of spillway and sluicing capacity to deal with floods of 225,000 cusecs flowing for 24 hours appears to be ample. This is 50,000 cusecs more than Sir Michael Nethersole laid down in his original Note dated 21st February 1916.

Afflux level likely to occur.—In paragraphs 12 *et seq.* the Executive Engineer has worked out in a most ingenious way what afflux is required in each reach to force the water of a maximum flood through that reach. In the end the various affluxes of the different reaches are totalled up and a level of 1,508.4 is anticipated at the Rajah's Summer House two miles below Bilaspore town. This is practically the head of the reservoir and as the reputed level of

the 1894 flood is said to be 1,510·0 it appears that so far from the site of the ponding up in a river with a steep slope the effect on surface levels in passing a big flood is negligible. If the reservoir level at Dam rises to 1,510 then we might say water would rise to 1,518·4 or say even 1,520·0 at the Summer House, but this is 10·0 feet below the level of the plinth; on the other hand, it is doubtful whether this level will ever be attained because by the time the reservoir level at the Dam had risen to 1,510·0 the peak of the flood would have passed the Summer House (Hardwar) and a much smaller volume in the river there would give a considerably lower water-level.

Silt deposited in the Reservoir.—In paragraph 19 and onwards Mr. Nicholson has gone into the question of deterioration of the reservoir.

In compliance with the instructions of the Chief Engineer in his Note dated 26th February 1916, based on Sir Michael Nethersole's remarks, elaborate silt observations were carried out at Bhakra and Rupar simultaneously. These are separately recorded in a bound volume. The Executive Engineer allows for an annual deposit of 6,250 foot acres of silt, which is 0·25 per cent. of the whole capacity of the reservoir. Then taking into account that as the capacity decreases less water is impounded, meaning a later closing of sluices, therefore less silt deposits and so on in geometrical progression the Executive Engineer estimates a life for the reservoir of 1,850 years.

I do not think we need look so far ahead. Even accepting a 0·25 per cent. deterioration annually the reservoir will last 100 years, and by that time the climatic and atmospheric conditions will have so altered by growth of trees, conversion of dry lands into cultivated that no doubt the rainfall in these tracts will increase and artificial irrigation may no longer be so necessary. However, even the shorter period of 400 years is still so far ahead that deterioration of the reservoir need not be seriously considered.

Probable Loss in the River from Bhakra to the Regulating Gauges.—In paragraph 5 of Bhakra Dam Report, Volume II, Part I, page 4, a loss of 10 per cent. is allowed for from Bhakra to the regulating gauges. The Executive Engineer in Part II, paragraphs 23 *et seq.*, makes an effort to show that so far from a loss there will be a gain. It would not be safe to count on this, nor even on neither loss nor gain, and a provision of 10 per cent. loss allows a margin of safety which will come in very handy for extensions if additional water is found to be available.

Reference Vol. IV, Upper Sirhind Canal.

Alignments.—The estimate prepared by the Executive Engineer, Rupar, is in accord with the instructions given by me after considerable discussion with Executive Engineers, Rupar and Project.

To force water into the canal to the extent of another 2,000 cusecs, it is essential that a level of 872·5 instead of 871·25 will be required in the pocket above the undersluices.

Bay No. 6 of the weir must be lowered by 1½ ft. and fitted with Stonev gates to facilitate regulation. In Bays 1 to 5 the crest of the weir must be raised one foot to prevent shutters being topped by the higher pond level.

The present gates of the existing undersluices will need an addition by way of splash boards to the upper gates to prevent their being topped by the higher pond level.

Main Line.—Carrying this extra supply in the present Sirhind Main Line presents no insuperable difficulties. At times of extreme demand there may be some difficulty in getting sufficient headway through the super passages and bridges for house boats, but irrigation requirements cannot be subordinated to traffic.

Combined Branch.—No comments.

Abohar Branch.
Bhatinda Branch. } —No comments.

Feeders.—The old channels to be silted up and handed back as credit to the Project.

Executive Engineer's anticipation that there will be high pressures on the back of the concrete of the side slopes in the adjacent and parallel new channels need not be considered seriously. Except near the syphons subsoil level though high would still be little if anything over bed level. The land under the old Feeders should be given up and a value credited to the Project equal to the difference between what was paid for the land originally and what is paid now.

The method of making a new Feeder only merging into the old channel at sites of masonry works is proposed as least likely to interfere with the existing channel and so work can proceed continuously and not only in rotational turns. If remodelling of existing channels during closures had been contemplated the time required for the work would have been fifteen years. To make the scheme productive we must take water across through the Patiala-Kaithal Feeder as quickly as possible.

The working of the Barna Dari Distributary will cause trouble, but with electric power available it should not be difficult to lift a few cusecs two feet and give good command. This matter will no doubt be settled amicably between the State and the Engineers when the time comes.

The Patiala-Kaithal Feeder.—Owing to the Feeder having to be taken across the Drainage of the country the connecting link between the present Sirhind and the Western Jumna Canal is the most important channel in the Scheme. The Executive Engineer's proposals are fully described and are in accord with the general instructions issued from time to time in consultation with the Chief Engineer, Mr. Holms.

The main features on which to focus attention are—

(a) To have a lined channel to avoid water-logging which would occur if the channels were unlined, in which case the seepage through the canal bed would put a subsoil barrier across the Drainage.

(b) To provide sufficient Drainage Crossings.

Both these considerations have been fully met.

Sirsa Feeder.—No comment.

Sirsa Branch, Middle Reach.—No comment.

Sirsa Branch Tail—Tohana Branch.—As a capacity of 960 cusecs will be available at the tail of the Sirsa Branch for extensions it has been deemed advisable to carry this in the Tohana Branch, which will then be linked up with the tail of the Sirsa Branch at mile 86, and take its place as a new channel for the last twenty miles.

This is not economically sound as we will be running water in two parallel channels, Sirsa Branch and Tohana, but it is forced on us by practical considerations. If we carry the extra 960, say 1,000, cusecs in the Sirsa Branch from its junction with the Sirsa Feeder at mile 33 it will involve a remodelling of 50 miles of the existing channel and it is doubtful if this could be done in rotational turns except over a period of many years. The ideal scheme would be to have—

(a) A smaller and independent Tohana Branch.

(b) Put the extra water into the Sirsa Branch after lining it.

The present Sirsa Branch with very slight alterations, but lined, would be able to carry the extra water required. This Project provides for the first method, but it should be incumbent on the Engineers who carry out this Project to prepare alternative estimates to see which scheme would pay, any extra cost of the lining being placed against considerable saving in absorption losses. The latter are estimated to be—

		Cusecs.
Sirsa Branch	...	119
Tohana ...	...	388
Total		507

of which at least 250 cusecs would be saved. By the time this work could be taken in hand, say in the 4th or 5th year of the programme for the whole scheme, officers will have gained much lining experience and will be able to arrive at a very accurate estimate of the cost of lining. The time factor of the Sirsa Branch is very low. By the time this work would be in full swing the linking up channel would be able to carry some stored water which will then be available. The Sirsa Branch could then be given a month of full supply at a stretch for sowing followed by long closures with intervals for 'Kor' and maturing watering. In these long closures lining work could be carried out, and no doubt the whole branch could be finished in the last five or six years of the programme.

Details of Work.

Reference Vol. IV, Upper Sirhind Canal.

A.—Preliminary.—No comments.

B.—Land.—The land rates in Ludhiana are very high and show a remarkable rise. When the original Sirhind Canal was made the same land was obtained at about Rs. 40 an acre and it is now at least double for barani and over four times for chahi. In Karnal and Hissar where canal irrigation has not yet extended the prices are moderate. It will no doubt facilitate acquisition of land in Native States Territories if each State appoints a Land Acquisition Officer of its own at the cost of the Project to work directly with the Executive Engineers and expedite acquisition.

D.—Regulators.—The provision of standard sized gauges and gearings is very sound.

All the designs are approved and have been carefully prepared. The Regulators at the bifurcation of the Tobana Branch and Sirsa Feeder provide for taking the former out skew. This is a very necessary alteration to the right-angled off-take in the alignment laid out during survey.

E.—Falls and Weirs.—No comment.

F.—River and Hill Torrents.—This is a most important subject as the existing Feeders and also the extension of the Patiala-Kaithal Feeder run across all the natural Drainages of the country.

Each work has been considered by the Executive Engineer in detail and the designs approved before being estimated.

The Executive Engineer's reports are full and need no further comment.

The waterways provided appear to be ample and have been fixed by me in consultation with Mr. Holms, Chief Engineer.

Administrative measures must be undertaken in co-operation with the Native States to prevent any of these Nullahs upstream of the Canal Crossing being tampered with. It is quite easy for irrigation purposes to bund any of them, but the result would be disastrous to the canal as such bunding only diverts the main floods and causes a new channel to form. For example, the Kapuri Bund has turned the Ghaggar, and large spills from it are now developing; what is now the Gadri may eventually become the main Ghaggar even before these works start.

G.—Bridges.—The provision for bridges is liberal and ample. Although foot-bridges were provided on the Triple-Project Canals it would be more in the interests of development to have nothing but cart-bridges.

The Distributaries from the Feeders are Native States' Channels and do no irrigation giving a credit to this Project. The cost of altering their heads into the new alignment is therefore placed in a sub-head by itself.

H.—Escapes.—None are required.

J.—Mills.—The provision is sufficient for the limited number of falls on this canal.

K.—Buildings.—The provision is sufficient, and as pointed out by the Executive Engineer is less than usual because of the large number of Rest Houses along existing channels.

L.—Earthwork.—The rates appear sufficient.

L.—Lining.—This is a new sub-head of earthwork or channel construction. The reasons for showing it separately are given by Executive Engineer and are approved. The question of lining as a necessity and of its advantages is dealt with by Executive Engineer in the General Report by him.

M.—Plantations.—The provision is moderate and is approved.

O.—Miscellaneous.—No comment.

P.—Maintenance.—Executive Engineer's method of assessing maintenance charges on a percentage of the works figure is sound and is approved.

Q.—Losses of Stock.—Seems to be a perfectly useless sub-head, but as it is laid down in Standing Order No. 144, dated 18th January 1913, Public Works Department Code, Volume III, a small provision has been made.

1.—3.—Distributaries.—The provision based on actual figures from a recently completed work seems sufficient.

1.—4.—Drainage and Protective Works.—It is essential that each big masonry drainage work on the Patiala-Kaithal Feeder is used only by the waters of the drainage intended to pass that particular work. It is therefore necessary that spill waters of each channel are confined to its own basin.

To avoid complaints of loss of cultivation and "Sailaba" due to cutting off of spill water, regulators in the bunds have been provided in the estimate. These will pass a certain amount of spill water under control.

1.—5.—Special Tools and Plant.—The provision of sufficient Railway Line suitably laid out and ample rolling-stock has been fully considered. If lined channels are made—and on this depends the success or failure of the Project—sufficient means of transport must be supplied to enable the work to proceed expeditiously and economically without breaks due to lack of materials.

The provision made for rolling-stock appears to be sufficient and was arrived at by Executive Engineer in consultation with undersigned after fixing the number of locomotives and wagons needed and spreading the cost over Works as a percentage charge.

II.—Establishment.—A new temporary Circle will be formed with four divisions. After completion of the whole scheme this Circle will merge into the existing Sirhind Canal Circle, while the Abohar and Bhatinda Branches, which will be cut off and fed from the new weir at Aliwal, will be merged in the Lower Sirhind Circle.

During construction there will be four Circles—

- (1) Bhakra Dam, Temporary.
- (2) Existing Sirhind Canal Circle, Permanent
- (3) Upper Sirhind, Temporary.
- (4) Lower Sirhind Circle, Permanent.

These will after construction be reduced to two.

The percentage of 12 per cent. was arrived at in this way.

On the Upper Jhelum Canal the expenditure was 14.3 per cent. on total Works without exempted charges. But in this estimate the main head "Works" contains a specially heavy provision for Tools and Plant greatly enhancing the total of that accounts head. Therefore 12 per cent. was considered a safe figure and provides a sum of Rs. 45,55,128.

This compares closely with figures obtained another way. It is anticipated 38 Division-Years will be required, which at Rs. 1,20,000 per Division Year (the cost of the Upper Chenab Canal), the amount required is Rs. 45,60,000.

III, IV, VI, (23), (25).—No comment.

VII.—Interest Charges—The Code Ruling is for 4 per cent., but in view of money stringency statements have also been drawn up showing results with 5 and $5\frac{1}{2}$ per cent. interest. As rates have already dropped to 5 per cent. it is likely that by the time the Project comes under construction money may be available at $4\frac{1}{2}$ per cent. For safety's sake, however, it is advisable to consider the financial aspect of the scheme on a 5 per cent. basis.

The Upper Sirhind cannot be considered alone; the whole Project must be considered together; therefore no further remarks on it need be made here.

Programme of Work.—This has been mapped out by Executive Engineer and myself in consultation. It is obviously not conclusive, but shows the general lines on which progress is required to give the best financial results.

Reference Vol. III, Lower Sirhind Canal.

Mr. Nicholson has described very fully the alignment of the Main Line and location of Headworks and there is no need to add much.

His paragraphs 13 and 14.—Headworks—Location.—The site of the proposed Headworks has been fixed as described by Executive Engineer by working back at the selected slope of $1/8,000$ from the existing Sirhind Canal below Daudhar Fall. Other conditions also taken into account were the physical features and that an excessively high weir would not be required. Regarding the physical features the river is tied in on the right bank by a high bluff and has been in that position, it is stated, for very many years beyond even the memory of the proverbial oldest resident. This reduces the necessity for training works.

The most serious objection to the site is that the high land on the left bank is at some distance, and in locating the Headworks station we have to repeat the very unsatisfactory conditions obtaining at Merala and Balloki, viz., a station situated on the low Khadir land between the canal and the river and liable to be badly affected by the supply in the canal and the ponding up above the weir. The former evil in this case will not be so serious as the canal is to be lined, but rise of subsoil water from the ponding up above the weir remains. A suitable site on the high land two miles off cannot be found as the village of Bundri occupies the only site and it may have to be considered whether this village should not be bought out and cleared up and the station built here.

An alternative site for the Headworks is three or four miles lower down the river near Gorsian village. Here the station could be built on high land above the Dhaya.

The objection is that to get the same level in the canal a higher weir would be required. On the other hand we would save in—

- (a) Diversion of the Budha Nullah.
- (b) No syphon under the Main Line would be needed for the intercepted drainage.
- (c) There would be 4 miles less of an expensive lined Main Line.

Regarding the higher weir at Gorsian the figures are—

Suppose we move down 20,000 feet—

Fall in Main Line to a slope of $1/8,000$

Fall in the River to a slope of $1/4,000$

Difference to be adjusted

2.5'

5.0'

2.5'

Thus we would need either 2.5' higher gates on the weir or a weir 2.5' higher above mean bed-level, entailing considerable extra expense.

The latter would give us extraordinarily good control of the river and anti-silting conditions in the canal, but whether there would not be attendant risks of high heading up on a sandy river bed remains to be seen.

In the design put up the difference of level from crest to undersluice floor is 8.0. If the lower weir site be selected the difference becomes 10.5. One of the first points to be decided by the constructors of the canal will be the selection of the site between these two alternatives. No doubt comparative cost will have an important bearing on this decision, but a good site for the station should be given very heavy weight even if the lower site is somewhat more expensive.

His paragraphs on Grey Canals.—This system of canals is reviewed separately. (See page 16.)

Main Line Lower.—No comment.

Abohar Branch Alterations.—This involves a lowering of the bed of the existing branch below the fall by 2 feet. No harm results therefrom and it cheapens the Headworks, otherwise we would have either to go further upstream to get the additional command or else raise the weir and gates by another 2 feet.

The remaining channels,—Abohar-Bhatinda Feeder, Phul Feeder, The Rori (A-9) Feeder, Bhatinda-Bikaner Feeder, Bikaner Branches—have been carefully selected and aligned and are fully described in the Report.

Aliwal Headworks—Mr. Nicholson has given a lot of thought to the design put up for the proposed Headworks and has collected plans of the various Headworks of the Punjab for several years and considered their working conditions together with the silt history of the off-taking canal for those years. From this investigation he advances certain theories which *prima facie* appear sound. But it seems to me that a Project is not the place for the advancement of new theories however sound. A Project Estimate is meant only to provide funds for the execution of a work and is therefore best prepared on already accepted lines. The final niceties of designs and their details involving new theories rest with the actual constructor of the canal later on. Therefore it will be the duty of the men who finally design and sanction these Headworks after the Project is sanctioned to pursue Mr. Nicholson's investigations further and try to find support for his views as embodied in the design.

Briefly stated, Mr. Nicholson in addition to commenting on necessity for good command to control silt deposits argues that in the past insufficient attention has been paid to the condition of the river downstream of the weir. To prevent aggregations of silt below the weir (as at Khanki) which interfere with its efficiency it is essential to maintain a narrow and deep channel and that the two channels on each flank must unite and make one channel about a mile below the weir. With this object in view the plan shows the attention paid to the downstream side of the weir, the river being confined by means of two heavy spurs into one channel centrally to the weir 5,000 feet away.

As stated the Headworks consist of a low weir flanked by undersluices on each side, the whole weir having Stoney gates instead of shutters.

Both undersluices are at a slight angle to the weir to assist by their inclination in the convergence of the two streams towards each other—which is considered so desirable.

Upstream of the weir the approach is through a bottle-necked entrance flanked by two heavy spurs. On the left the spur is connected to the Headworks by a continuous guide bank. This is not considered necessary on the right where the high bank affords sufficient protection. The other salient features of the design are sufficiently described by Mr. Nicholson.

His paragraph 4.—It is usual to allow 1.0 freeboard from top of gates to ponded level. Even less might do, but in a high wind waves splash over. Therefore ponded level could usually be 760.5. In paragraph 7 Mr. Nicholson calculates a ponded level of 760.1 will suffice, leaving a margin of 0.4.

Mr. Nicholson has, however, ignored the reduction in value of a coefficient flowing over a broad crest compared with over a rising sill gate. Extensive observations were made in Rupar in 1909 by Messrs. Baij Nath and Hindley and the result of the observations are abstracted thus:—

MOVEABLE SILL DOWN.		MOVEABLE SILL UP (PARTIALLY).	
Free.	Drowned.	Free.	Drowned.
0.557	0.607	0.85	0.847

This establishes clearly that over the broad crest in operation with the moveable sill down we get a much smaller coefficient and we cannot accept the coefficient of 0.82 taken by him unless it flows over a sill. Therefore if the conditions sketched by him prevail the discharge will only be as 0.6 is to 0.8 or say three-quarters what he estimates.

It is true he has a margin of 0.4 against the ponded level, but then again there is the risk of some silt getting into the canal either by careless regulation or by keeping the canal open a shade too long in a rising flood during periods of very keen demand, and this margin would disappear. Therefore to get Mr. Nicholson's coefficient of 0.82 which is correct over a gate sill it is essential that the flat masonry crest should be lower, and I would make it only 9'0" high instead of 10'5"—the difference can always be made up by the rising sill.

It would also have the further advantage that in the winter when there is little or no silt in the river we could force full supply into the canal (which itself will be 1,000 cusecs less owing to the Grey Canals being closed) with a lower pond level—an advantage in every way as it would mean a steeper slope to the river and a smaller area of lake, thereby reducing evaporation losses.

No change is made in the drawings or estimates as this involves no extra cost; it is only mentioned here so that this is not lost sight of when the weir is being designed finally.

His paragraph 11.—The weir is calculated to pass 200,000 cusecs with an afflux of 3'0". This is ample. In fact advantage might be taken of the damping down effect on floods of the Dam itself to build a shorter weir. It is extremely doubtful whether anything like such a flood will even reach Aliwal once the Dam is built.

In Volume II, paragraph 13 of Part I, General Report, the maximum discharging capacity of spill-ways and top sluices is shown to be 150,000 cusecs, the remainder being absorbed into the reservoir storages there described. The maximum flood discharge ever recorded at Rupar with an unrestricted river higher up was estimated to be 225,000 (*vide* Superintending Engineer's No. 402-C., dated 28th July 1916, and in reply Chief Engineer accepted 260,000), a large margin of safety.

Now it is known that as a river gets further into the plains the steadying effect of spills and flatter slopes gives floods of less intensity, but spread over a longer period. A glance at the River Discharge diagrams in our blue books shows the enormous drop in volume between say Gandasinghwala and Adamwahan. It is therefore quite reasonable to accept the fact that the probable maximum which has ever passed Aliwal was never more than 200,000. But now we propose to damp down the Bhakra floods from 300,000 to 150,000—a loss of 150,000.

Therefore I should be prepared to reduce the 20,000 maximum flood at Aliwal to 150,000 cusecs—that is, the same as passes Bhakra—the steadying effect of spills and reduction of discharge thereby would compensate for the volume entering the river catchment area below Bhakra. We could thereby reduce the length of the weir by one-quarter.

No change is suggested in the design and estimates at this stage as we are aiming at a liberal estimate, but this is mentioned so that the point is borne in mind for further consideration before actual construction begins.

All other details of design are fully explained by the Executive Engineer and are good. }

Description of Works.—These have been fully described by Executive Engineer, and any remarks I could make are only those I have already made about the various sub-heads of the Upper Sirhind Canal. Those remarks apply *mutatis mutandis* to similar works in this estimate. The only strange sub-head is G. I.—*Canal Crossings*.

These are for distributaries of the present existing Sirhind Canal which will in future get water from the Upper Sirhind. They thus form no part of the irrigating system of the Lower Sirhind and cannot therefore be classed under *Distributaries*. Neither are they *F.—River and Hill Torrents* nor *F.-1.—Other Cross-Drainages*, nor are they chargeable to *Drainage and Protective Works*. They are really bridges carrying water instead of roadways; therefore they are shown as Canal Crossings under a separate sub-head G. I.

The system is complicated and the arrangements for maintaining existing irrigation have been carefully thought out and indicated in the report and in the very good plane-table surveys 4" = 1 mile and 1" = 1 mile sheets bound up.

Reference Vol. III, Lower Sirhind Canal. Review of Mr. Nicholson's Report on the Grey Canals.

Mr. Nicholson has written a history of these canals, the measures suggested before the Irrigation Commission for dealing with them and proposed in the Project to keep the Grey Canals supplied with water.

The construction of the proposed Lower Sirhind Headworks at Aliwal eight miles above the head of the first Grey Canal, the Kingwah, makes it essential that means for keeping them supplied with water should not be overlooked. Local civil authorities seem to consider it undesirable to take over these channels, and therefore all we can do is to give a Feeder Channel, the alignment of which is described in paragraph 21, page 40 of Volume III.

The ideal system of course would be to align an entirely new system of distributaries, but this cannot be undertaken unless and until either Government is prepared to enforce its right to stop irrigation unless conducted on proper lines or the zamindars in a body demand being absorbed into a regular canal system and undertake to pay a full water-rate.

In paragraph 16 of his Report the Executive Engineer estimates the 25th May and 21st September as mean dates of opening and closing of these canals so that they run less than four months. During September with heavy silt in the channels the volume of water in the canals must be very small. Thus while the maximum discharge of all these canals is 2,148 cusecs, the average for the crop must be a good deal less. Unfortunately there are no reliable records to say what their average is. Under the proposals in the Project between 1st May and 1st October it will be possible to give these channels 1,000 cusecs steadily and with regulators at the heads of the off-taking canals this water can be given in rotational turns. Thus each channel will run full in turn or need not at all—an efficient system of distribution. Under the existing system unless the river is high the low supplies in the canals have no command and large areas can get no water at all. There will be a large gain in efficiency.

Paragraph 19.—The average irrigation is given as—

Kharif	...	...	...	...	35,701
Rabi	...	...	...	...	32,274
			Total	...	68,975

Paragraphs 20 and 23.—The supply promised of 1,000 cusecs with a Full Supply Factor of 70 will give 70,000, a marked increase over the average. The people will thus have no grounds for complaint as to loss of irrigation.

Paragraph 24.—This Feeder channel by itself will be a non-remunerative item in the Project, but this cannot be helped unless the whole area has a scientifically designed system aligned for it. Not only would it be possible to get the best results from the water supplied, but it would be possible to give more water and spread it over a much larger area than that served by the existing channels if the existing channels were scrapped and entirely new ones designed.

Reference Vol. V, Western Jumna Canal.

The proposals for extensions on the Western Jumna Canal as now embodied and made part of the Sutlej Dam Scheme contain nothing new. They were all fully worked up in great detail in the Sarda Ganges Project by Mr. T. R. J. Ward, C.I.E., M.V.O., at that time Superintending Engineer, Western Jumna Canal. That scheme has fallen through, but as water is now available from the Sutlej Reservoir to take up the Sirsa Branch, the idea of these extensions and increase of intensity on existing irrigation can be revived by utilizing the Jumna water set free.

These extensions of the Western Jumna Series form no integral part of the new canals to be made from the Bhakra Dam, but in virtue of the fact that they only become possible by reason of the Sutlej water received, the cost of their construction and the revenue expected to be realized are debited and credited to the whole Sutlej Dam Scheme.

As already stated, Mr. Ward's estimate has been boldly drawn on to make up these estimates with additions to cover the rise in prices since that Project was prepared or to cover small modifications found necessary after discussing the proposals with the Superintending Engineer of the Western Jumna Canal—Mr. G. O. Laurie.

Special Plans and Drawings have not been prepared as those in the portfolios of the Sarda Ganges Project suffice.

The money provided is liberal and far more than Mr. Laurie considered necessary. There should therefore be no difficulty in getting the work done for the money provided.

After construction is finished in view of the close interlocking of the two systems—Sutlej Dam Canals and Western Jumna Canal—it would be advisable to combine the capital accounts of the present Sirhind, New channels of the Upper and Lower Sirhind and the remodelled Western Jumna Canal and have one revenue account. It would be impossible to tell annually what irrigation has resulted from the 1,200 odd cusecs set free in the Sirsa Branch. On new distributaries this information would be available, but as some of the new irrigation will be done on existing channels in the form of increased intensity it will be impossible to sort out how much is creditable to the Sutlej Dam Canals and how much to the Western Jumna Canal.

Again, if the cost of the Sirsa Branch only be transferred to the Sutlej Dam Canals the cost of the share of reservoir and cost of the share of Headworks, Main Line and Feeders is still unknown and forms a charge to the Western Jumna Canal, against which must be placed original cost of bringing Jumna water to the Sirsa Branch from Tajewala. As so many unknowns creep in, it will be far more satisfactory to have one account for both canals.

Appreciation.

Mr. H. W. Nicholson has been connected with the Project since the formation of the Division in October 1915. He has brought to the work untiring zeal and energy, and as a result has produced in this province of large canal schemes a monumental Project—second to none—not even to the rightly famous Triple Canal Project. His penchant, however, for delving into archaic records of long forgotten files and reports and into every collateral subject connected often only indirectly with the work in hand has caused no doubt some delay in the completion of the Project, but, on the other hand, it has led to the collection of a valuable set of records and data which will be useful to the seekers after knowledge of the future. He is leaving these records well arranged and easy to trace.

Mr. D. J. Morris, Executive Engineer, was attached to my office during the last six months of the constitution of the Project Division to assist me in the heavy burden of carrying on the routine of a large Circle simultaneously with seeing the preparation of a big Project through the last stages. He was of unflinching assistance and help. He carried out monotonous routine duties most cheerfully and at the same time gave ready help on the final preparation of the Estimate of the Dam and wrote a most valuable note, Appendix A-2 to Volume II. He was most indefatigable and thorough in all he undertook.

To Mr. F. O. Glass, Temporary Engineer, we are indebted for a most useful collection of accurate maps of the whole country between the Sutlej and Jumna served and to be served by canals under this scheme. This officer's well-known reputation as a Surveyor needs little further commendation from me, and I can only add that when the needs of the Empire called him away to a wider sphere of action in Mesopotamia in June 1918 the finishing-up work of completing the Project maps was seriously hampered by the loss of his guiding hand.

Lala Ajudhya Nath, Assistant Engineer, posted to this Division as an apprentice fresh from college, also did excellent work under Mr. Glass. He also compiled an independent investigation into the maximum floods of the Sutlej above Bhakra,—a creditable piece of work for so young an officer. He has also gone to Mesopotamia as Assistant to Mr. Glass.

Lala Ganpat Rai, Assistant Engineer, on probation, did useful work in the early surveys for this Project in 1916-17.

I concur in Mr. Nicholson's recommendations on his staff of Subordinates, Clerks and Draftsmen, who worked hard and well.

The above mentioned officers and men deserve the thanks of Government.

E. R. FOY,

Superintending Engineer, Sirhind Canal Circle.

PART II. GENERAL REPORT BY Mr. H. W. NICHOLSON, EXECUTIVE ENGINEER.

1. Origin of the Project.

A DETAILED history of the development of irrigation in the tract between the Sutlej and the Jumna Rivers is given in Appendix A.

The waters of the Sutlej above the junction with the Beas, and the Jumna being fully utilized in existing canals, has always appeared a hopeless bar to perennial irrigation ever being introduced into the famine-stricken tracts beyond the limits of the irrigation of the existing canals.

Proposals to take the waters of the Beas River across the Jullundur Doab into the Sirhind Canal and the Sarda River across the Ganges and Jumna Rivers into the Western Jumna Canal have both been considered, the latter proposal being worked up into a complete project.

The Punjab Government have recently in the letter, dated 23rd April 1919, to the address of the Government of India, definitely given up their proposed share of water from the Sarda-Ganges-Jumna Scheme.

(Sd.) H. W. M. LIVES—21-5-19.

Both of them, however, failed to mature because the water could be more efficiently utilized elsewhere.

A Project for a Dam on the Sutlej, 1/4 of the capacity of that now proposed was worked up and abandoned in 1911 as the lines on which it was developed gave no hope of its being a financial success. A Project for a Dam on the Jumna was also worked up, but abandoned as the foundations at the site proposed were found to be unsuitable, and the supply in the Jumna is only in excess of that required in existing canals for a comparatively short and very uncertain period of the year.

The Sutlej River carries a much greater and more certain supply for a longer period than the Jumna and is a much more favourable river on which to construct a large storage reservoir. The above are briefly the facts and considerations which led to the formation of the Project Division, in which the Project now submitted has been prepared.

2. Surveys.

Reservoir Area.—A double-levelled circuit was taken from Rupar up to and round the whole reservoir area; 1,450 and 1,500 foot contours were laid out along the whole length levelled over. The 2"=1 mile Survey Maps giving 50 foot contours were found to be so accurate that no further surveys were found necessary to determine the volume of the reservoir.

A detailed tachometric contoured survey of the Bhakra Gorge was made on a scale of 1/1,000 to give a detailed plan for the location and design of the Dam.

Nearly 200 discharges were observed of the river at Bhakra to calibrate the gauge at that site and a hydrographical survey was made of the River Sutlej from Daher Suspension Bridge as well as of all the tributary torrents between that point and the Dam site.

The whole of the information collected is bound up as "Bhakra Reservoir, Field Records, 1918," Volumes I to III, which are not submitted with the Project.

In addition to the above, 1,064 experiments were made to determine the silt burden of the water in the river. The detailed report on these is given in Volume II, Part V, pages 76—81.

Headworks at Aliwal.—A plane-table and level survey 4"=1 mile was made of the River Sutlej from the Phillour Railway Bridge to below Sidhwan, based on the pillars of the Riverain Boundary Survey fixed by the Survey of India Department; a copy of this map is given in the folio of plans.

Phillour-Jagraon Tract.—Mr. Glass's Ferozepore Surveys of 1908 came up to near Sidhwan; the stones of his last base line were utilized and two more bases 5 miles apart were laid down and the country in between contoured for the alignment of the Main Line.

The detailed reports, etc., in connection with the above two items are bound up in a volume "Phillour-Jagraon Surveys, 1916-17, Field Records," which is not submitted with the Project.

Sirsa A-9 Rori-Chautala Tract.—Mr. Fleming's Surveys of 1905, with all the records in connection therewith existed, but there was an error in the levels which he was aware of, but had been unable to rectify.

A double level party was sent to connect up the bench marks of his survey, and in the end the error was discovered and the levels corrected after which the map was recontoured.

The reports, etc., in connection with this tract are bound up in a volume "Sirsa A-9 Surveys, 1916-17, Field Records," which is not submitted.

Alignment of Lower Sirhind Canal Channels.—These were all laid out plane-tabled to a scale of 4" = 1 mile and double levelled.

The reports, etc., in connection with this work are bound up in a volume "Lower Sirhind Canal Alignments, Fields Records," which is not submitted with the Project.

Patiala-Kaithal Tract.—This was contour surveyed, bases being laid down 5 miles apart and stones fixed at 2,000 feet intervals.

The alignments of the Feeders and the Tohana Branch were laid out plane-tabled to a scale of 4" = 1 mile and double levelled.

The reports, etc., in connection with these items are bound up in a volume "Patiala-Kaithal Surveys, 1916-17, Fields Records," which is not submitted with the Project.

The surveys of the Ghaggar and tributaries are all being reproduced and bound for record as they will be most valuable at some future date owing to the unstable nature of those channels. The original surveys by Captain Baker in 1840 and Mr. Rundle in 1878 were discovered and found to be invaluable in showing the nature of the changes that are taking place.

Sirsa-Bikaner Surveys.—For the tract south-west of the Sirsa-Rewari Railway no surveys existed and the whole tract between the Chautang and the Ghaggar was contour surveyed, bases being laid down 10 miles apart with stones at 2,500 feet intervals, in continuation of Mr. Glass's Bikaner surveys of 1906—08. The reports in connection with the surveys are bound up in a volume "Sirsa-Bikaner Surveys, 1916-17, Field Records," which is not submitted with the Project.

Bikaner State contributed Rs. 24,500 towards the cost of this Survey in proportion to the area which lies within the State. For the Ferozepore and Bikaner tracts Mr. Glass's 1906—08 surveys existed and were invaluable.

For the rest of the area within the limits of the Project various surveys existed which were obtained with much difficulty after personal search in various offices. In very few cases did duplicates exist, and there was little or no information to show the datum on which the levels were based.

It should be noted that in their new publication the Survey of India have changed the values of their bench marks, but the original Sirhind Canal and Western Jumna Canal were based on the old values.

In all the surveys that have been done by Mr. Glass and in this division all levels are reduced to the old values of the G. T. Bench Marks so as to be the same as that of the existing canals.

Too much importance cannot be attached to following this procedure when the execution of the Project is put in hand or there will be hopeless chaos in levels.

A line of precise levels 80 miles long was run from Ludhiana to Bhatinda by Mr. Glass, and it was found that the closing difference from the G. T. values was only 0.28 feet, and that the recorded values of many of the canal

bench marks had been sadly mutilated in the course of time, even errors of 10 feet being found.

Generally it was found that the level surveys of 1878 and thereabouts were far more reliable than those of more recent years.

The utmost confidence is felt regarding the accuracy of the levels in the surveys now done and in the designs submitted with this Project, due to Mr. Glass's long experience of defeating the shoddy methods of the average surveyor. Also the keenness of the officers in charge of the parties in the fields no doubt assisted in producing the satisfactory result that only a small amount of field work had to be rejected for inaccuracy.

The field work of the surveys was completed by May 1918 when the preparation of the Project Estimate was begun, but there was an enormous amount of work involved in indexing and recording all the field records.

The field records, survey maps and plans in bound folios with Tables of Contents of all the Volumes are in the Punjab Irrigation Secretariat, Lahore.

The following is an abstract of the field work done :—

Theodolite work	... Triangulation stations fixed	... 22 Nos.
Do.	... Traverses and Base lines	... 743 miles.
Do.	... Alignment of channels	... 560 „
Levelling ...	... Double Precise Levelling	... 2,090 „
Do. ...	... Single Levelling	... 8,260 „
Do. ...	... Cross-sections of Rivers and Nullahs levelled.	900 Nos.
Plane-tableing	... Tacheometric Traverse	... 103 miles.
Do. ...	... 4" to 1 mile scale	... 467 sq. miles.
Do. ...	... 1/1,000 scale	... 2,244 sq. chains.
Do. ...	... Contouring on village maps in Reservoir area.	105 Nos.
Demarcation and Permanent marks.	12 feet high burjis	... 238 „
Do.	... Concrete or masonry burjis	... 2,307 „
Do.	... Other bench marks	... 1,804 „
Miscellaneous	... Wells measured	... 583 „
Do. ...	... Discharge observations	... 400 „
Do. ...	... Silt Experiments	... 1,064 „
The total area in the plains contoured is		... 2,564 sq. miles.
The area covered by the Reservoir is		... 18,000 acres.

3. Limits of the Scheme.

The object aimed at in the preparation of the Project has been to extend irrigation, irrespective of territorial boundaries, up to the physical limits of command, in the tract between the Sutlej and Jumna Rivers, which is neither at present irrigated nor comes within the scope of the Lower Sutlej Valley Project now under consideration in 1919.

No attempt has, however, been made to give irrigation in the tract north of the existing Sirhind Canal which has a favourable rainfall of 2" or over (see map A, Appendix G), although that could have been done by taking a canal off the Sutlej some distance above Rupar.

If the water power available at Bhakra is developed into a hydro-electric scheme, it will be possible to introduce irrigation in the tract north of the Sirhind Canal by the introduction of tube wells.
(2d.) H. W. M. Ives—21-6-19.

The general map (scale 1" = 4 miles) accompanying this report shows in flat washes the new areas in which irrigation is provided.

It will be seen that from Delhi to the Ohautang Nala near Hissar irrigation is provided up to the absolute limit of command.

The same remark holds good for the tract west of the Ghaggar.

Between the Ghaggar and the Chautang irrigation is provided for the whole area down to the Rajputana-Malwa Railway between Sirsa and Hissar. South-west of this Railway line there is a large area of land, the whole of which, in the initial instance, it has not been possible to arrange to irrigate.

Some of the land in this latter tract is unirrigable on account of its irregular surface, but sufficient water is available to provide the intensity of irrigation proposed in a gross area of 453,333 acres, which forms a considerable proportion of the area. The remaining portion of the area will be benefited by the extension of kharif irrigation therein from the Ghaggar Nala as described later (paragraph 21).

At any rate the fact that there is an area in which further water can be utilized is an insurance that should the demand not arise in the tracts for which it has been provided, or should the increase of efficiency in the use of water make supplies surplus, there would always be this tract in which it could be utilized.

Very remote indeed.

(Sd.) H. W. M. Ives—21-5-19.

The presumption that there would be surplus water available is a very remote contingency.

The Grey Inundation Canals from the Sutlej above Ferozepore will be absorbed and given a controlled supply, and so far as possible the small inundation canals from the Ghaggar and its tributaries will be abolished and perennial irrigation provided.

These Grey Canals will become so called "Non-perennial" channels.

(Sd.) H. W. M. Ives—1-5-19.

The intensity of irrigation in the distributaries of the Sirhind and Western Jumna Canals will be brought up to a uniform basis in those cases in which it is below the general standard.

The total gross commanded area within the limits affected by the project is 11,808,188 acres. This area is equal to the sum of the gross commanded areas of the following existing canals:—

Upper and Lower Jhelum,

Upper and Lower Bari Doab,
and Sidhnai.

Upper and Lower Chenab,

Upper and Lower Sutlej,

The total irrigation at present done in the tract is 1,977,000 acres and this will be doubled by the Project.

The total new area to be commanded is 4,667,047 acres and the irrigation percentage will be increased in 2,205,737 acres through the existing channels.

Thus of the 11,808,188 acres within the limits of the Project, irrigation will be given for the first time or intensity increased in 6,872,784 acres, while the method of supply will be changed to most of the remaining area.

It will thus be seen that the Project is unique and complicated in its scope and nature.

4. Available supplies.

This question is dealt with at length in the Report on the physical conditions in connection with the Dam, Volume II, Part II, page 21.

There is no supply in the Sutlej during the Rabi which can be reckoned on as being available: on such few occasions as the records shew any, it is due to a slack demand on the Sirhind Canal during October on account of heavy and late rains, or to a closure of the canal in the spring in order to carry out works which cannot be done when the canal is running.

The capacity of the reservoir proposed up to the normal water surface of R. L. 1,500 is 2,583,550 foot acres, or 112,540 million cubic feet. With the reservoir filled up to 1,510 R. L. (the emergency level provided in the design for the control of a maximum flood coming on a full reservoir) the capacity would be 2,763,125 foot acres, or 120,362 million cubic feet. No doubt after a few years' working and experience of floods and their action it may be

1 acre foot = 48,560 c. feet.

(Sd.) H. W. M. Ives—22-5-19.

possible to utilize this extra storage as has been done at the Periyar Reservoir in Madras, but for the present it has been neglected.

It is assumed in the Project that a stored supply will be required for the 6 months of the rabi crop, 1st October to 31st March, and April, the first month of the kharif crop, or 210 days in all.

The mean discharge over a period of 210 days will therefore be 6,203 cusecs, working on the capacity of the reservoir at normal level.

An arbitrary allowance of 10 per cent. for losses *en route* from the Dam to the regulating gauges of the canals has been made which gives a mean discharge of $6,203 - 620 = 5,583$ cusecs available at regulating gauges.

In the detailed report above referred to it has been shown that there is not much likelihood of any material loss in the river bed down to the canals, and that there is a mean discharge of 200 cusecs during the rabi in the river at the site of the Aliwal Headworks for which no credit has been taken.

If the most optimistic estimate be taken of working the reservoir up to 1,510 R. L., giving 2,763,125 feet acres capacity, or 6,633 cusecs for 210 days. With no losses in transmission and assuming credit for the 200 cusecs mean discharge in the river at the site of the Aliwal Headworks the mean discharge available would be $6,633 + 200 = 6,833$ cusecs, or 1,510 cusecs more, i.e., 24 per cent. increase.

It will thus be seen that the mean estimated rabi discharge of 5,168 cusecs on which the Project is based is a cautious forecast.

During the kharif there need be no question of supplies being sufficient or not because provision has been made for a stored supply for 30 days at the beginning of the crop in case the river does not rise in time.

5. Areas commanded by the Project.

Statement showing by Canals the present and proposed gross areas within the limits of the Project.

Serial No. of System.	Name of the System.	Source of information.	GROSS COMMANDED AREA (ACRES).			
			Total of the present areas.	Portion on which intensity will be increased.	Total of the new areas.	Grand Total of the proposed canals.
1	2	3	4	5	6	7
1	Upper Sirhind Canal ...	Statement, Appendix C-4 and C-7 of Vol. IV, Upper Sirhind Canal.	1,430,057*	1,113,527	1,780,622	3,160,679
2	Lower Sirhind Canal...	Statement, Appendix B-1 of Volume I & II, Lower Sirhind Canal.	1,65,155	565,782	2,421,207	4,671,422
3	Western Jumna Canal ...	Statement, Appendix F., pages 34-35, Volume V, Western Jumna Canal.	(2,673,409)* 2,102,529	526,428	473,165	3,575,687
4	Area commanded by State Branches from Upper Sirhind Canal System.	Statement, Appendix C-4, page 101, Vol. IV, Upper Sirhind Canal.	1,958,400	...	42,003	2,000,400
		Totals ...	7,141,141	2,205,737	4,667,047	11,808,188

*670,580 acres transferred from Western Jumna Canal to Upper Sirhind Canal system.

The statement above shows the gross area within the limits of irrigation of the existing major canal systems to be 7,141,141 acres and out of this the intensity of irrigation will be increased in 2,205,737 acres, while another 4,667,047 acres will be brought within command, making a total gross area for the Project of 11,808,188 acres.

The statement on the next page shows the territorial distribution of the gross areas to be brought under command for the first time by the Project.

In the general map 1" = 4 miles accompanying this report the areas to be irrigated are distinctively coloured by flat washes as shown in the legend thereon, kharif irrigation being distinguished by stripes instead of flat washes. Areas in which the intensity of irrigation will be increased are given a flat green wash.

**Statement showing by Canals the new Gross Area within the Limits
of the Project by Territories.**

Name of the Territory.	Description of Tract.	GROSS COMMANDED AREAS (ACRES).			REMARKS.
		Detail according to tracts and territories.	Total of each territory according to different systems.	Total of the different systems of the Project.	
1	2	3	4	5	6
	(1) UPPER SIRHIND CANAL.				
Patiala ...	North of Ghaggar ...	68,000			
Do. ...	Between Ghaggar and Sirsa Branch ...	106,000			
Do. ...	South of Sirsa Branch ...	59,200			
Do. ...	Dudhal Tract ...	89,000	267,200		
British ...	Patiala to Sirsa Branch ...	800,000			
Do. ...	Tohana-Rangoi Tract ...	362,000			
Do. ...	North of Sirsa Branch and south of Ghaggar.	38,000			
Do. ...	Barwala Extensions ...	211,200			
Do. ...	South-west of Sirsa Branch ...	409,000			
Do. ...	Hissar Distributary Irrigation ...	18,889			
Do. ...	North of Ghaggar through State channels	42,000	1,374,089		
Bikaner ...	South-west of Sirsa Branch ...	181,333	181,333	1,772,622	
	(2) WESTERN JUMNA CANAL.				
British ...	Beri Bhalaut and Pai Rohana ...	89,594			
Do. ...	Toham Extensions ...	169,872			
Do. ...	South-west of Hissar ...	47,388			
Do. ...	Extensions from Sirsa Branch of Chautang Distributary.	61,859	378,658		
Jind ...	Toham Extensions ...	74,500			
Do. ...	Dadri Extensions ...	20,000	94,500	473,158	
	(3) LOWER SIRHIND CANAL.				
British ...	Ferozepore District ...	80,000			
Do. ...	Muktsar Hithar ...	80,000			
Do. ...	Grey Canals ...	425,000	595,000		
Faridkot ...	Through Abohar Branch ...	140,000	140,000		
British ...	Rohri-Chataula Tract ...	612,000	612,000		
Bikaner ...	Ditto ...	69,000			
Do. ...	From Bikaner Branches ...	1,005,267	1,074,267	2,421,267	
Grand Total of the Project ...				4,667,047	
ABSTRACT.					
	Total new area of Patiala State ...		267,200		
	Ditto of British Territory ...		2,959,747		
	Ditto of Bikaner State ...		1,205,600		
	Ditto of Jind State ...		94,500		
	Ditto of Faridkot State ...		140,000	4,867,047	
					* Of this total 595,000 acres area is of Kharif only.
					† Kharif only.

6. Probable area of irrigation.

The new distributaries on the Upper and Lower Sirhind Canals are designed on the same basis as the existing distributaries, i.e., with a full supply factor of 170 acres per cusec capacity at distributary head.

On the Western Jumna Canal the figure is 150 acres owing to the fact that the rabi supply on the Western Jumna Canal is much lower than in the Sirhind Canal.

Diagrams E and F, Appendix G, shew in blue the mean ten daily discharges utilized in the Sirhind and Western Jumna Canals, respectively. The unutilized capacity of the main line during periods when there is a surplus supply in the river above requirements is coloured red.

It does not mean that there is sufficient surplus water in the river throughout the whole period coloured red to run full supply, as the records are not sufficiently accurate to give that information.

It will be noticed from the diagrams that the Sutlej River has surplus supply over a much longer period than the Jumna River which often fails to carry a sufficient supply to comply with indents in the kharif months even in June and July.

There is frequently confusion in the use of irrigation data owing to ill-defined terminology and the fact that the data for different canals and in different years are not reduced to a common basis.

The terms used in this project are as follows :—

Average Discharge.—The sum of the daily discharges during a crop divided by the number of days the canal is in flow. The average discharge really means nothing for statistical purposes as it is not a measure of the amount of water passed into the canal but is only a measure of the rate of discharge when the canal is open.

Mean Discharge.—The sum of the daily discharges divided by the number of days in the crop.

The mean discharge is a definite measure of the amount of water passed into the canal in a crop.

Time Factor.—The ratio of the number of days the canal is in flow during the crop to the number of days in the crop, then Mean Discharge = Average Discharge \times Time Factor.

Capacity Factor.—The ratio of the amount of water passed down the channel during the crop to the total amount which would have passed had the authorised full supply of the channel been run full time or

$$\text{Capacity Factor} = \frac{\text{Mean Discharge}}{\text{Authorised Full Supply}}$$

It is this capacity factor in a crop which controls the amount of irrigation that may be expected.

It should be borne in mind that $\frac{\text{Average Discharge}}{\text{Authorised Full Supply}}$ does not give capacity factor, but $\frac{\text{Average Discharge}}{\text{Authorised Full Supply}} \times \text{Time Factor}$ would. Unfortunately all the statistical statements maintained in the Irrigation Branch are based on the average supply which makes correct comparison between canals or from year to year on the same canal impossible.

$$\text{Full Supply Factor} = \frac{\text{Area irrigated on a channel.}}{\text{Authorised Full Supply at head of channel.}}$$

$$\text{Duty} = \frac{\text{Area irrigated on a channel.}}{\text{Mean Discharge of head of channel.}}$$

$$\text{Full Supply Factor} = \text{Duty} \times \text{Capacity Factor.}$$

The amount of irrigation to be expected is obtained by multiplying the authorized supply of the channel by the Full Supply Factor, which itself depends on the two factors of Duty and Capacity Factor.

The Capacity Factor on canals heretofore has depended on the natural flow of the river in the rabi and the demand in the kharif. In the case of the Sutlej Dam Project Extensions the Capacity Factor will be fixed by the amount of water stored and the capacity of the distributaries, due allowance being made for losses *en route*.

When the Project was started the figure of 6 was taken as the time factor in the rabi at Garhi and the whole Project outlined on that basis, the time factor being taken as being the equivalent of capacity factor.

This, however, only had the effect of limiting the total capacity of the new distributaries to be designed.

As a matter of fact the true values of the capacity factors are :—

For the various Punjab canals ... Statement 2, Page 55, columns 12 and 13
 „ Sirhind Canal in detail ... „ 10 „ 63 „ 6 and 7
 „ Sirhind and Western Jumna „ 17, „ 70, lines 25 and 26.
 Canals by the sections
 into which they will be
 split by the Project.

It will be seen from statement No. 2 that the mean capacity factor at distributary heads on the systems as a whole in the last 5 years' average is—

					<i>Kharif</i>	<i>Rabi</i>
Sirhind	...	...	...	...	44	52
Western Jumna Canal	...	...	...	...	52	40

This shews that the rabi capacity factor of 52 actually holding in the past on the Sirhind will be materially exceeded by that of 60 on which the total capacity of the distributaries to be supplied by stored water was fixed.

This will mean an increase of about 16 per cent. and 50 per cent., respectively, in the supply of rabi water available for the Sirhind Canal and the portion of the Western Jumna Canal, which will come on to the new Sirhind system. There will be no change in the capacity factor of the rabi supply available on the Western Jumna Canal as readjusted.

The kharif capacity factor on the Sirhind Canal is only a measure of the demand for water and could be materially increased if the cultivators could be induced to work harder in the fields on kharif cultivation.

On the Western Jumna Canal the kharif capacity factor is probably restricted by the shortness and uncertainty of supply in the River Jumna referred to above.

The duty is the measure of areas irrigated per cusec of water run in the crop.

Heretofore it has been assumed that a greater rainfall would assist in giving a higher duty; that is, a greater area of crop would be irrigated in the higher reaches of the canals where the rainfall was greater.

Statement 17, lines 27, 28, 32 and 33, tend to show that in tracts of less rainfall the duty is higher contrary to the usual expectation. The question of intensity affecting the duty must be borne in mind when making the comparisons by taking into consideration lines 10 and 13 at the same time; the deduction is that in tracts where there is less rainfall the cultivators are more careful irrigators.

It follows, therefore, that for the new tracts to be irrigated by storage a higher full supply factor may be anticipated than on the existing canal due to—

- (a) increase in capacity factor,
- (b) irrigation being in tracts with lower rainfall giving higher duty,
- (c) higher intensity of irrigation giving higher duty,
- (d) the supply will be under control of a reservoir so that the water will be given for use when it can be most efficiently used.

Or 25 per cent. over the actual full supply factor of 170 at distributary heads on which the channels have been designed.

(Sd.) H. W. M. Ives—22-5-19

On the consideration of the above, the full supply factor of 212.5 has been accepted at distributary heads.

It may be noted that on the Abohar Branch below Daudhar, statement 17, column 4, line 23, a full supply factor of 240 already holds. In Mr. Gibb's Sutlej Valley Project a full supply factor of 208 was accepted.

On the Western Jumna Canal the full supply factor of 150 is maintained as the excessive cultivation of sugarcane, which takes water in both crops, keeps down the full supply factor far below what it would be if the cropping were normal, and this fact would justify a heavy increase in the sugarcane water rate.

A full supply factor of 100 has been taken for kharif channels as has been found to hold at present. For the Grey Canals, however, the figure of 70 only has been taken owing to the inefficient nature of those canals.

Statements 15 and 16 shew that the total area of crop matured on the canals in the rabi very closely depends on the amount of water utilized at sowing time especially when the climatic conditions before and at that time are taken into consideration.

The fact that the depth of water taken on the Western Jumna Canal is much higher than on the Sirhind Canal is due to the fact that there are larger areas of sugarcane being irrigated at the same time. No attempt has been

The proportion of Kharif to Rabi depends largely on the conditions of the soil to grow the various crops. A wheat-producing tract is not likely to suddenly become a Kharif-producing tract.

(Sd.) H. W. M. Ives—22-5-19.

made to fix the proportion of rabi and kharif irrigation. Statement 17, line 15, shows that it varies between 1 to .9 and 1 to 2.2. This proportion adjusts itself and cannot be fixed beforehand.

7. Existing irrigation and nature of crops.

The existing Sirhind, Western Jumna and Ghaggar Canals worked by the Irrigation Department already irrigate in the tract under report. The division of the agricultural seasons into kharif and rabi holds throughout. It is hardly possible to give the areas of existing cultivation and crops over such a large area involving areas in so many Native States.

Diagrams G, H, I, J and K, Appendix G, however, give in diagrammatic form the total areas matured on the major canals for the 25 years ending with the rabi of 1915-16, showing the chief crops and the water-rates assessed.

It will be noted that the greater part of the rabi crops is cereals, wheat and barley, with a considerable area of gram, but a very small area of oilseeds is grown.

The kharif cropping on the Western Jumna Canal consists of a large area of cotton, and a relatively large area of sugarcane with a small area of rice, millets and fodder.

The kharif cropping on the Sirhind Canal consists of small areas of sugarcane and cotton, considerable areas of maize, the remaining area, more than half the whole, is millets and fodder.

The people in the tract maintain large numbers of cattle for which the fodder is cultivated and do a considerable trade in dairy produce (gher).

On the Sirhind Canal at present most of the cultivators are able to make such handsome profits out of their large holdings in the rabi from cereals due to ample supplies of rabi water that they are but little inclined to undertake the strenuous work of cultivating high class kharif crops in the hot weather.

I don't think so. The Sirhind Canal tract is essentially a wheat-producing tract, and so its Rabi irrigation is bound always to exceed the Kharif

(Sd.) H. W. M. Ives—22-5-19

There is no doubt that as large a proportion of cotton could be grown on the Sirhind Canal as on the Western Jumna Canal if the cultivators could be stimulated to undertake its cultivation.

There is every hope that the next few years will see a great change in this direction. Mr. Jesson, Executive Engineer, who worked hard in stimulating the growth of American cotton on the Lower Bari Doab Canal, is now doing the same in the Ferozepore Division of the Sirhind Canal with most satisfactory and encouraging results.

There appears to be no object in considering the cropping now existing on the new areas to be irrigated, as the introduction of irrigation causes a change in the nature of the husbandry and is almost sure to induce the cultivation of higher class crops as it has done on the existing canals.

8. Produce per acre and fair money value of nature to the chief crops.

The necessity for discussing these points is laid down in paragraph 737 of the Public Works Department Code, Volume I, but the question is one of such magnitude and so controversial that little can be said on the subject.

Diagrams L to V, Appendix G, however, give the information available with reference to the existing Sirhind and Western Jumna Canals and the Ferozepore and Hissar Districts which are irrigated from the two canals, respectively, and are typical of the new areas to be irrigated.

The rates of outturn per acre are taken from the figures given by the Director of Land Records.

There is no doubt that owing to the steady growth of the export trade from the Punjab due to the development of communications and the demand in England the prices of the produce will in future remain at much higher rates than have held in the past as the prices in Mark Lane practically control the prices in the Punjab.

It has been customary to take credit for water-rates, an occupiers' rate which is supposed to be the fair market value of the water, while the owners' rate is assumed to be half the increased rent, which the owner of the land can get from the tenant owing to the land being irrigated.

The history of the development of this procedure is complicated, and in the case of the Sirhind Canal Government annually loses a large sum in revenue owing to the fact that no indirect revenue (owners' rate) is taken on the areas irrigated from the Government channels in Native States.

The Sirhind Canal in this aspect is unique amongst all the canals in the Province, and it would appear desirable to remit the indirect revenue assessed in the British Districts which have all been settled in recent years with the exception of the Sirsa Tahsil now coming under settlement this year. A full occupiers' rate could then be taken, which would bring in a very material increase in revenue, which is their due, to the Imperial Government.

The question of water rates is being dealt with by the Chief Engineer in consultation with the Financial Commissioner and has been dealt with elsewhere.

A copy of all the correspondence with the Financial Commissioner on the subject of occupiers' rates is attached at the end of this volume, for information (Appendix E).
(Sd.) H. W. M. IVES - 22-5-19.

9. Rainfall.

The question of rainfall in connection with the reservoir does not arise, the catchment area of the Sutlej above the Dam site is so great, viz., over 18,000 square miles that nothing would be obtained by any attempt to consider this point; the river always has supplies in excess of the storage required.

The monsoon rainfall affects only a very small portion of the catchment of the river above the Dam, but as Simla, the Headquarters of the Meteorological Department, is in the catchment area and only about 40 miles from the Head of the Reservoir, valuable information will always be readily obtainable regarding the probability of phenomenal storms arriving, which would be of great use to those responsible for the working of the Reservoir.

From the records dealt with it appears to be the usual provision of nature that in years when the monsoon rainfall in the plains is subnormal, there is normal or in excess of normal rainfall in the hills or *vice versa*, thus in years of greatest demand for irrigation in the kharif there is an ample supply in the rivers.

In preference to giving statements of rainfall an Isohyetal Diagram is given (map A. Appendix G), based on figures obtained from the Director of Land Records and from Canal Rain Gauge records. From this it is seen that nearly the whole of the tracts to be irrigated have a mean annual rainfall of less than 15" and a large portion less than 10". The diagram shows the mean rainfall for the 3 months—January to March—when the crops are maturing is less than 2" over nearly the whole tract proposed to be irrigated.

The rainfall over the tract in question is also subjected to severe vicissitudes. At Hissar the mean annual rainfall is about 14" yet in 1917-18 27.5" were recorded and in 1896-97 only 5.5" were registered. Owing to the fact that 37.5" is so much above the mean there are more years with a rainfall of less than the mean than there are years with a rainfall in excess of the mean.

This makes the call for irrigation more acute than if the rainfall were more regular.

10. Subsoil water in the tract.

Maps B and C, Appendix G, accompanying this report shew the present depths to spring level and subsoil water levels over the whole tract so far as data exist.

The data concerning the tracts irrigated by the Sirhind and Western Jumna Canals are complete since the year 1895 when the present system of well measurements was initiated.

The information for the remaining areas has been obtained from the well measurements made in connection with the present surveys, Mr. Glass's Bikaner Surveys and the surveys done in the Special Drainage Division of the Western Jumna Canal.

The diagrams for the first time shew all the information available and are of great interest. It will be noticed from map B (Appendix G), how near the surface the subsoil water is in the upper reaches of the existing Sirhind Canal and the eastern portion of the Western Jumna Canal systems.

The Ghaggar Nala appears to have a far greater effect in keeping up the subsoil table than would have been expected, especially below Sirsa where the effect of the Otu Reservoir is most marked.

There is a well below Otu which was sunk 70 feet to get to water at the time of construction but now there is 50 feet of water in it shewing the rise in subsoil water caused by the construction of the Otu Reservoir.

At Hanumangarh there is an ancient and complete well, the curb of which is only 40 feet below natural surface but now subsoil water level is 160 feet below natural surface. This gives some indication of the changes that have been brought about by the decrease in flow of the Ghaggar Nala at that point.

The subsoil water level in the greater part of the tracts into which irrigation is to be extended is from 100 to 150 feet below natural surface. The water when obtained is brackish and generally undrinkable so that the introduction of irrigation will give benefits which will be more appreciated by the inhabitants than by any one reading up this report without any knowledge of the local conditions.

It was desired to compile a similar map showing the change in spring level since the construction of the existing canals, but the data available at the time only dealt with changes since 1895.

In the report on the Lower Sirhind Canal, Volume III, two diagrams, G and H, are given showing the information abstracted from the well measure-

ments made at the last two settlements of the villages in the Ludhiana and Ferozepore Districts

This was the best information available at the time to show the rise in spring level in that tract.

The Main Line of the Lower Sirhind Canal is aligned through a tract of high spring level, and it is essential that this channel should be lined or the whole of the tract below Moga will probably become waterlogged.

The Abohar, Bhatinda, Phul and (A-9) Rori Feeders are aligned along the slope of the subsoil table and cross the natural drainage lines. If these channels were constructed as ordinary earthen channels, acute conditions of waterlogging would follow at once in the upper reaches and extend down the alignments in the course of time. It is therefore absolutely necessary to line these channels at the outset, whether the expenditure involved were justified by the saving in absorption losses or not.

The Feeder Channels of the Upper Sirhind Canal from the tail of the Main Line to the Sirsa Branch are aligned through a tract of high subsoil water level and also across the natural drainage lines of the country so that in their case also it is essential that they be lined at the outset.

Since the diagrams referred to above were prepared it has been found possible to trace the rise in subsoil water level from a far earlier date than 1895. On the Sirhind Canal a series of well measurements was maintained on a different basis to that introduced in 1895 from as far back as 1871 and the complete records exist in the Sirhind Canal Circle Office.

The survey sheets of the original project surveys for the Sirhind Canal existing in the Circle and other offices are found to contain full information of the depth to water surface with the values of Bench Marks on each well.

From this information and the measurements recorded in Captain Baker's surveys of 1840, the effect of the introduction of irrigation in raising spring level could be studied over a much more extended period. It would, however, take unnecessary time to pursue these investigations further just now in any detail.

From the study of a few individual wells it has been found that the rise has been as much as 60 to 80 feet over large areas.

It may here be recorded that in large tracts of the Ambala District, although the subsoil water table is at a reasonable depth, it is practically impossible to do well irrigation. The subsoil is such that no strata can be found which will yield a supply sufficient for well irrigation purposes.

11. Famine tracts that will be protected.

A detailed report on the subject of famine in connection with the Project is given as Part IV of this volume, in which it is shown that in the 1899-1900 famine in the Delhi Division alone 1,223,600 head of cattle were lost (Appendix B-9).

It may be useful here to refer to the famine protective aspect of the Sutlej Dam Project briefly. In paragraph 2 of Chapter XIV of their report the Irrigation Commission classified Hissar and Rohtak Districts as the two worst in the Punjab, the index numbers representing the percentage of crops matured in the famine year of 1900 on the normal area matured being 16 and 26, respectively, the greater part of the latter area was matured by irrigation from the Western Jumna Canal in a small portion of the districts. In their general report, paragraph 15, they also point out that the south-east Punjab in a fifty years' period is subject to 13 dry years, which include 5 years of severe drought; this tract ties with the Madras Deccan for the first place in the list, for the greatest liability to experience dry years. It was noticed that the importance of irrigation varied inversely with the amount and certainty of the rainfall; on this basis these districts would justify the heaviest expenditure on irrigation over any district in India. Later, in paragraph 107 of their report, the Irrigation Commission by their formula justify an expenditure of Rs. 221 per acre in providing irrigation for Sholapur. The cost under the Sutlej Dam

Project will only be about Rs. 75 per acre. The culturable area brought under command of this project is about 4,151,000 acres in all, of which some 1,530,000 acres are in the Native States of Patiala, Bikaner, Faridkot and Jind, and the area to be irrigated will be not less than 40 per cent. of the culturable area commanded. It is well known that the inhabitants of the dry tracts deliberately intermarry with those of the irrigated, and in years like this migrate with their cattle to the villages of their more fortunate connections and eat them out of house and home. Thus the profits of the irrigator is only in degree less secure than that of the dry land cultivator ; and the advent of complete protection throughout the tract secured by storage should raise the scale of living and encourage intensive cultivation. 'This must lead to a rise of occupiers' rates that will react favourably on the finances of this project. It is customary to base the financial forecasts on the statistics of the past ; this not only leads to under-valuing the returns of such a scheme as this in its project stage, but is likely also to result in under-assessing the occupiers' rates when irrigation is about to be started.

12. Bhakra Dam.

Below the village of Bhakra the Sutlej River, before debouching into the plains, has broken through the Naina Devi Range of the Sub-Himalayas, composed of Nahan Sandstone Rocks, at right angles to their strike.

Mr. Vredenburg, Superintendent of the Geological Survey of India, inspected the site and his report is given in Volume II, General Report, on the Bhakra Dam Project (Appendix A—I).

He pointed out that the strata strictly correspond on either side of the gorge and are connected without any break from one side to the other below the bed of the river, and that the hardness of the rock is proved by the narrowness of the gorge, whilst the height of the range is due to the great simplicity of the rock structure at this point. The dip of the strata at the site proposed for the Dam is about 75° in a south-west direction (the river flows south-west through the gorge). The natural structural conditions, he maintains, are such that the proposed dam and the rock on either side should afford one another mutual support ; and the construction of a dam at this site will be equivalent to restoring a small portion of the original rock barrier that has been eroded by direct river action. 'The abruptness, continuity and altitude of the ridge testifies to the sandstone's hardness and resistance to disintegration ; below the reach of weathering the rock will be found still sounder and the haunches of the dam, if carried far enough into the sides of the gorge will be secure of thoroughly sound unweathered rock. He adds " that the homogeneousness of the sandstone band is a favourable feature as regards the rather remote contingency of damage through earthquake, whilst the great depth of the gorge will induce conditions analogous to those of an underground mine where earthquake effects are at a minimum ".

It will be seen that the site is ideal and the project has been prepared for a Dam 395 feet high above foundation, which will hold up the river to form a reservoir with its ordinary ponded water surface at 1,500 feet above mean sea level, but this might allow provision of an additional 10 feet of storage as an emergency level.

The Dam is designed arched on plan with a radius of 573.7 feet, giving a crest length of 1,050 feet in the gorge, which is 900 feet wide at that level. The width of the gorge at river water surface is only 200 feet. The total cost of the Dam with all subsidiary work and including all charges is estimated at Rs. 3,93,74,490. Further details are given in the General Report on the Bhakra Dam, Volume II, Part II.

The Reservoir.—The river has a mean slope of about 8 feet to the mile. A large tributary torrent runs down the valley the opposite direction to the river which it meets just before it turns through the gorge in the range in the south side of the valley. The total length of the reservoir from end to end will therefore be about 50 miles.

The area of waterspread at R. L. 1,500 is 17,468 acres (27.4 square miles) with a capacity of 2,583,550 feet acres or 112,540 million cubic feet.

At R. L. 1,510, the highest level to which water may rise in flood, the lake will be 18,378 acres in area and contain 2,763,125 foot acres, or 120,362 million cubic feet.

The storage of the Assuan Dam as originally constructed was 36,000 million cubic feet and since the Dam has been raised to store water to R.L. 112 metres its capacity has been increased to 75,000 million cubic feet. The Bhakra storage will therefore be 60 per cent. in excess of that of the Assuan Dam after raising.

The Submerged Area.—The submerged area in the Bilaspur State is 12,816 and in British territory 4,674 acres; of these areas 3,245 and 1,415 acres, respectively, are classed as cultivated, the remainder being either grazing areas or unculturable waste. The population of both States, which will have to be displaced, is likely to be 1,795 souls; about 145 villages are affected; in about 70 of these houses are submerged; but in 25 of these less than 10 houses will be affected. The temples, etc., submerged are small and unimportant.

The estimated cost of compensation for the area submerged by the lake is Rs. 27½ lakhs.

In the detailed report on the physical conditions in connection with reservoir, Volume II, Part II, page 26, it is shewn the capacity of the reservoir will not materially deteriorate for 200 years.

13. Railways.

For the construction of the Dam a railway to Bhakra is essential, it is presumed that the North-Western Railway will construct the line from Ludhiana to Rupar (44 miles) in any case.

A separate report is reproduced in Volume II, Part IV, on the Railway Line required from Rupar to Bhakra (40 miles) with a branch to Nalagarh Quarries (10 miles) from which place it is proposed to obtain stone for use on this as well as on the Sutlej Valley Project.

The case of the Railway line to Bhakra has been referred to the North-Western Railway, but so far they have been unable to give an opinion. In any case funds have been provided in the Project to construct the line to the open line specification.

During the period of construction it will be far more convenient for the Irrigation Branch to have its own Canal railway from Rupar to Bhakra and to the Quarries at Nalagarh. The former can be sold to the North-Western Railway when construction is finished.

(Sd) H. W. M. 1115—23-5-19

For the carriage of materials for construction, temporary railway lines will be required along all lined channels where it has not been possible to align the channels along existing railway lines.

The details of these lines has been dealt with in the reports on the Upper Sirhind and Lower Sirhind Canals.

Upper Sirhind Canal.—A temporary railway line will be required along the Feeders, 92 miles from Doraha to Tik Railway Station through Patiala, as described in paragraphs 93—95, page 21, of the "Description of Works," Volume IV, Upper Sirhind Canal Report. It would be desirable on the completion of the work to maintain the length of this line below Patiala as an open line to Kaithal, since communications of any kind in this tract do not exist, and with the development of irrigation the need will be more acutely felt than at present.

Lower Sirhind Canal.—A temporary line will be required from Aliwal Headworks along the Main Line and Feeders to the tail of the Rori Feeder—95 miles.

The Bhatinda-Bikaner Feeder and the Bikaner Main Border branches total up to 108 miles in length, but for the greater part these channels are aligned along existing railways, so that lengths of 8 miles broad gauge and 11 miles narrow gauge track only will be required, which can be picked up and relaid as necessary. Details of these arrangements are given in paragraphs 91—95 of "Description of Works" in the Lower Sirhind Canal Report, Volume III, Chapter IV, pages 31-32.

Of these Railway lines the length of 21 miles from Ajitwal to Headworks will be required permanently unless a Railway line to Headworks is laid on a shorter route from Jagraon.

It would appear desirable for the question of improved Railway communications in this tract to be considered. With the river trained at Aliwal Headworks, it appears that to continue the Railway line from Jullundur to Nakodar across the river at Aliwal and on into Jagraon would give a most desirable chord line the length of which would be but little in excess of the canal line from Ajitwal to Aliwal, which it would replace.

This is a question for the Railway Department to consider.
(Sd.) H. W. M. Ives—23-5-19.

The money sunk in the canal line from Ajitwal to Aliwal would be a charge to the Province and bring in no revenue, whereas were the proposals now made carried out, communications would be improved and revenue earned on the capital sunk.

The rest of the temporary line from Ajitwal to the tail of the Rori Feeder, about 70 miles, would not be required on the completion of the work, and it would appear to be a favourable opportunity to use the permanent way material to construct a chord line through what is one of the largest areas unintersected by a Railway, viz., the Ludhiana-Dhuri-Bhatinda-Ferozepore rectangle, which is a well populated and irrigated tract.

This is a question for the Railway Department to consider.
(Sd.) H. W. M. Ives—23-5-19.

If the Jullundur-Jagraon chord were carried out as proposed, it might with advantage be carried on to Bhatinda. In the south-western portion of the tract involved in this project, there are only the two narrow gauge lines, Bhatinda to Hissar, and Suratgarh, respectively. With the development of irrigation there will be an urgent call for improved Railway communications to meet the export of produce from the irrigated lands.

This is a question for the Railway Department to consider.
(Sd.) H. W. M. Ives—23-5-19

14. The New Sirhind Canals.

It was not possible to increase the capacity of the existing Sirhind Canal Main Line to carry the supply for all the extensions desired.

It was therefore decided to build Headworks for a new canal lower down the river which would supply the lower portions of the existing Sirhind Canal British Branches and the new channels proposed. This will irrigate the areas lying north of the Ghaggar and south-west of the existing Sirhind Canal.

The relief afforded to the Upper Sirhind Canal by the Lower Sirhind Canal supplying the lower reaches of the existing British Branches of the Upper Sirhind Canal amounts to about 3,500 cusecs. This 3,500 cusecs capacity set free with an increase of 2,000 cusecs in the capacity of the Main Line, Upper Sirhind Canal, gives about 5,500 cusecs capacity at the tail of the Main Line available for extensions.

From the tail of the Main Line a new Feeder will be constructed past Patiala, to supply the Sirsa Branch of the Western Jumna Canal at Chandana, where the capacity is about 1,200 cusecs. The remaining capacity suffices to supply the requirements of the new irrigation proposed from what will be called the Upper Sirhind Canal.

The Western Jumna Canal Modifications.—The capacity of about 1,250 cusecs in the Sirsa Branch of the Western Jumna Canal transferred to the Upper Sirhind will then become available in the Western Jumna Canal to carry out the extensions proposed from the canal as it will then be constituted.

The constitution of the existing canals and the changes of source of supply of the various areas that will take place is given in statement 17, Volume I, attached to this report.

15. Upper Sirhind Canal.

The capacity of the Main Line of the existing Sirhind Canal, 39 miles long, will be increased from 8,500 to 10,433 cusecs, an increase of about 2,000 cusecs.

The Headworks at Rupar will need but little alteration and on the Main Line earthwork in raising the banks in certain lengths is all that is required to carry the increase in maximum gauge from 12.0 feet to 13.5 feet.

No alteration to masonry works on the Main Line will be required, as the canal was constructed for navigation purposes and there is ample headway under the bridges.

The details of the capacity of the canal are given in diagrammatic form, at page 88 of Volume IV, the report on the Upper Sirhind Canal. Appendices C-2 to C-7 of Volume IV, pages 90—107, give complete details of the capacities of the various channels.

Appendices C-8 to C-25 of Volume IV give in abstract tabular form all other information that has been collected concerning this canal.

The Abohar Branch will be fed at mile 13 below Daudhar Fall by the new Main Line of the Lower Sirhind Canal, the reach from the Head at Bhowani to this place will be abandoned as an irrigating channel and only maintained as an escape or Feeder channel to the Lower Sirhind Canal for use in case of rotational working should no supply need be passed below Rupar Headworks in the river.

The distributaries which take off the abandoned reach of the Abohar Branch will be supplied by a small Feeder distributary which will be constructed as a lined channel along-side the existing branch as detailed in the statement, Appendix C-6, accompanying the Upper Sirhind Canal Report, Volume IV, pages 104-5.

The Bhatinda Branch will be supplied by the Lower Sirhind Canal at Dhipali, mile 58.5. The channel below Talawal Fall, mile 41.3, will be abandoned and the capacity of the head reach will be decreased as given in the statement, Appendix C-5, accompanying the Upper Sirhind Canal Report, Volume IV, pages 102—33.

The amount of absorption saved by the abandoning of the reaches above described is given in statement, Appendix C-20, accompanying the Upper Sirhind Canal Report, Volume IV, page 129.

The existing Feeder with a head capacity of 3,080 cusecs taking off the tail of the Main Line will be abandoned and a new lined feeder with a capacity of 8,614 cusecs constructed alongside it to Patiala (40 miles) and thence to the Western Jumna Canal at Ghandana on the Sirsa Branch.

The separate Feeder is proposed as it would not be possible to enlarge and line the existing Feeders and keep irrigation going simultaneously, while it would be an inefficient arrangement to have two separate channels running side by side.

The existing Feeders belong to the Phulkian States, and it is proposed to construct the new Feeder at the cost of the British Government and deliver the water direct into the Phulkian States branches, Kotla, Ghaggar and Choa up to the authorised capacity of 3,080 cusecs. Thus the States will benefit to the extent of not having to bear the absorption loss which now takes place between Manpur and the heads of State branches mentioned.

An extra supply of 66 cusecs will be given to the Ghaggar Branch for irrigation of the British tract at the tail of the branch and north of Ghaggar.

From the tail of the existing feeders the canal will continue as the Patiala-Kaithal Feeder, a lined channel with a capacity of 5,135 cusecs, to near Pehowa (36 miles), irrigating all the land to the south-west *en route* where it will bifurcate into the Sirsa Feeder and Tohana Branch.

The alignment is particularly difficult on account of the fact that it crosses a large number of drainages, which are referred to in paragraph 18 of this report and in further detail in the report on the Upper Sirhind Canal, Volume IV, pages 13—15.

The Sirsa Feeder, a lined channel, is 11.2 miles long with a head capacity of 1,571 cusecs, sufficient to supply the portion of the existing Sirsa Branch below Chandana and extensions proposed therefrom.

The Tohana Branch, an unlined channel, 83.2 miles long, will feed distributaries irrigating the whole of the unirrigated area between the Sirsa

Branch and the Ghaggar. It will meet the Sirsa Branch near Guniana, supplying all the existing distributaries which take off the Sirsa Branch below this point as well as new distributaries to be constructed to supply the area of irrigation it is proposed to take up to the south-west.

Full details of alignment and works are given in Volume IV of the Project.

16. Effects on canals below the junction of the Sutlej and the Beas.

The capacity of the canals at present taking off the Sutlej above its junction with the Beas is —

Sirhind Canal, Existing (Perennial)	..	..	8,500 cusecs.
Grey Canals, Existing (Kharif)	...	...	2,148 „
			<hr/>
			10,648
			<hr/>

The capacity of the canals on the completion of the Project will be —

			<i>Rabi.</i>	<i>Kharif.</i>
Upper Sirhind Canal	...	...	10,174	10,433
Lower Sirhind Canal	...	...	7,602	9,259
			<hr/>	<hr/>
			17,776	19,692
			<hr/>	<hr/>

At present the capacity of and demand in the existing Sirhind are such that the whole rabi supply of the River Sutlej is utilized and the whole of the increased supply required in the rabi will be obtained by means of water stored in the reservoir during the month of August.

At the commencement of the kharif the rivers rise owing to the melting of the snows and the natural conditions are such that when the river begins rising the rise is very rapid. The increased maximum demand due to an increase of capacity from 10,648 cusecs to 19,692 cusecs or 9,044 cusecs early in May after stored water has been drawn off and when the demand is usually low, will have no material effect on the supplies available at the junction of the two rivers.

During the month of August the whole natural flow of the river above Bhakra will be controlled by the Dam, only sufficient water being passed down the river to satisfy the demands in the two Sirhind canals, the remainder will all be held up in the reservoir until it is full by 31st August or earlier date.

After the reservoir is full, the natural flow of the river will be passed on until such date as it ceases to satisfy the demands on the perennial portions of the Sirhind canals.

It now remains to be seen whether the filling of the reservoir in August, as above described, which means that the River Sutlej will be dry below the Aliwal Headworks of the Lower Sirhind Canal, will prejudice the supplies available for the Lower Sutlej Valley Project also drawing its supplies from the Sutlej below the junction of the Beas.

Looking at the question on broad lines it might be assumed that if in the Sutlej there is sufficient surplus supply to fill a reservoir of 2,500,000 foot acres in under the month, that in the River Beas the conditions of flow would be similar and that there would also be a greater supply available than would be likely to be required for the canals proposed in the Sutlej Valley Project.

The year 1918 has been one phenomenal for the lowness of the Sutlej River in August. The run off in August is lower than anything recorded in the last 10 years during which accurate records have been maintained at Bhakra (see Report Bhakra Dam, Volume II, statement 1 and diagram 15). It is therefore reasonable to assume that this year would be the worst on record for the Beas.

Fortunately daily discharges were regularly observed for the first time this year on the Beas at Pang where it breaks through the last range of hills into the plains, a site similar to Bhakra. The object being to obtain a calibrated gauge at a suitable site to give daily discharges from gauge readings as has been done at Bhakra.

Attached is a diagram W (Appendix G), which gives hydrographs of the Sutlej and Beas for the months of May to October 1918.

From an inspection of this diagram it will be seen that on only two days in August was the discharge in the Beas at Pang less than 20,000 and on only three more days was the discharge at Pang less than the full capacity of the Sutlej Valley Project canal system, viz.:—

Upper Weir, Risti Canal	...	..	.	8,726
Pakpattan Canal		...	...	7,683
Lower Weir, Bahawalpur Canal	...	...	...	5,888
Mailsi Canal	..	...	..	4,710
				<hr/>
				27,043
				<hr/>

Now it should be borne in mind that this hydrograph of the Beas is obtained at Pang, and that below that point there is a large catchment area and there will be natural inflow into the river. There will also be inflow into the Sutlej from the Aliwal weir to the junction.

Further, it should be borne in mind that lower down the river at Gandasinghwala owing to the large capacity of the river channel that after the river has once risen in June and July the minima at Gandasinghwala do not fall as low as the minima further up owing to the steadying effect of the capacity of the river channel and its creeks which tend to damp the variation of discharge in the river lower down.

From the daily data available for the worst year on record it may be said with confidence that the supplies are sufficient, especially when it is borne in mind that the maximum capacity of the canal system and not the probable demand is being compared with the available river supply.

17. Silt and Sediment.

The Public Works Department Code, paragraph 738, lays down that the fertilising and other properties of the sediment and the water to be utilized shall be discussed, yet so far in projects heretofore submitted, nothing has been said on this point probably for lack of information.

In the report on Silt Experiments 1916, reproduced in Part V, Volume II, the quantity of silt carried by the water has been investigated but there has been no scientific investigation into its properties or that of the water.

There is no doubt that the silt brought down in the early hot weather by the snow water must be of a different quality to that brought down by the monsoon rainfall run off, as the silt is brought from areas of entirely different geological formation.

It is probable that the silt brought down by the melting snows has far less fertilising properties, as it contains little or no humus.

On the other hand, the water in the river on the first break of and through the monsoon is very highly charged with humus and nitrogenous matter as is evident to the nasal organs of any one who has been at Rupar or any headworks through a hot weather.

From the quantitative analysis of the silt entering the canal, it is estimated that about 4,000 foot acres of silt per year are deposited on the fields irrigated.

The Sirhind Canal tract has always been described as being sandy. Mr. Mullaly, who was on the construction of the canal when he first joined

the Department and retired as Chief Engineer, stated just before retirement, after passing through the tract again, that he was astonished to see the change that had taken place.

The tract when he first knew it was so sandy that he doubted the possibility of the success of the canal but in the course of time the sand seemed to have vanished and the soil assumed a different texture.

Assuming that 4,000 feet acres of silt had been passed into the system for 30 years, 120,000 feet acres of clayey silt would have been deposited on the tract and with continual cultivation this would have been ploughed in and bound down an enormous area of sandy soil and drift sand to form a good loam.

There is no doubt that this change is fully appreciated by the zamindars as they state that continual canal irrigation stiffens up the soil, making it less suitable for barani (rain) cultivation. For this reason with the low intensity of irrigation given they keep definite areas of the village for canal irrigation, leaving the other areas unirrigated purposely so that they may remain in better condition, i.e., more porous, for rain cultivation.

In dry tracts for which this Project has been prepared no area can possibly be reserved for rain. It must all be canal-irrigated or be waste as at present.

(Sd) H. W. M. 1175-23-5-19

The writer in the course of his touring has also noticed the difference in texture of soil in the irrigated portions of sandy villages.

The evidence is put on record so that anyone inclined to take a pessimistic view, of the light or sandy nature of any portions of the tracts it is now proposed to irrigate, may be reassured that even the lightest soil is improved by continuous silt deposits year after year.

18. Drainages.

These are described in the physical description of the tract, Part III, paragraphs 2-8, pages 72-3.

The Feeder taking off from the Main Line, Upper Sirhind Canal, at Manpur and finishing at the Sirsa Branch crosses the Ghaggar and all its tributaries, the last half of its length passing through the middle of what is known as the Closed Drainage Tract. In the upper half the drainages known as the Lissara, Sirhind, Choa and others are already crossed by the existing Feeders.

The alignment of the channel through the tract and the design of the masonry works for passing the canal across the drainages have involved much investigation and consideration and the results arrived at appear to offer a satisfactory solution of all the difficulties encountered in dealing with such problems. Further expenditure has been provided for to cover cost of Drainage and Protective Works which will control the nalas in their approach to the canal crossings.

To fulfil the scheme of this Project it has been decided that it is not only desirable to open out the Sarusti Nala as an efficient drainage, relieving the existing conditions of flooding around and below Pehowa, but such provision of measures to prevent flooding must be antecedent to bringing that area under a proper irrigation system.

The matter has been dealt with apart from this Project and is only referred to here. Whether the canal comes or not the clearing out of the Sarusti Nala outfall must be taken up.

See my Note attached (Appendix A-2).

(Sd) H. W. M. 1118-23-5-19.

On the Lower Sirhind Canal, apart from the ordinary drainage lines in which flow only takes place in years of excessive rainfall, there is only one drainage crossed.

This drainage, the Budha Nala, is really an old bed of the Sutlej River which it abandoned some 140 years ago. Now its only source of supply is the famed Machhiwara Jhil through which the winding channel runs from Chamkaur under the old river bank past Ludhiana to Bhundri.

The Nala will be diverted into the River Sutlej above the training works of the Aliwal Headworks: the run off from the small area left inside

the upstream marginal bund will be passed under the Main Line of the Lower Sirhind Canal in a siphon.

In dealing with the case of the Budha Nala it has been found that if the channel were dredged out and straightened an outfall from the Machhiwara swamps could be obtained with an efficient slope of 1 in 2,700, this would effectually remove the trouble experienced in connection with this unhealthy and malarious tract. Its clearance is a question which might well be taken up by the newly established Drainage Board.

19. The Sarusti Canal.

This Inundation Canal is a District Board Canal which was constructed some 20 years ago. It draws its supply from a small reservoir formed by bunding a jhil on the course of the Sarusti Nala, but which is silting up and in the course of time will lose its storage capacity.

The supply of water in the Sarusti Nala is extremely uncertain and inversely in proportion to the demand, as in years of poor rainfall the Nala is practically dry the whole season.

The greater part of the area commanded by this small canal will be absorbed in the area commanded for perennial irrigation from the Upper Sirhind Canal.

The water stored in the reservoir can be utilized by passing it into the perennial canal system, if desired. There is, however, a favourable site for constructing a similar reservoir some miles higher up where the Sarusti Nala crosses the Delhi-Ambala Road near Thanesar. The water stored there could be utilized for irrigation of the tract above the limits of command of the New Upper Sirhind system.

The cost of the Sarusti Canal system, including the Bund, was about Rs. 2 lakhs, no provision has been made, however, in the Project for purchasing the canal from the Karnal District Board, as it is presumed that such portion of the distributary system as will be absorbed, will give a saving in the cost of construction of new distributaries, which will suffice to compensate for the channels taken over.

The sum at stake though is so small in comparison with the amounts involved in the whole Project that it has not been worth while to consider the matter in detail.

20. Rangoi Canal.

This Inundation Canal is merely a development of the Choya or Joya Nala, which is an extinct bed of the Ghaggar. Like the Sarusti its supply is uncertain and inversely proportional to the demand.

The area irrigated in a favourable year is only a few thousand acres. In a poor year it is practically nil.

The zamindars who get a supply from the so-called canal will probably only be too pleased to forego any rights they may have in order to get perennial irrigation.

In any case the question is one so small as not to in any way materially affect the Project.

The canal for a time was managed by the Irrigation Department, but a few years ago it was handed back to the District authorities.

21. Ghaggar Canals.

These Inundation Canals were constructed by the Irrigation Department as a famine relief work in 1897 and are supplied from a reservoir formed in the bed of the Ghaggar by the construction of the Otu Bund and Weir.

The northern canal will be abandoned as the irrigation from the tail reach in Bikaner territory will be replaced by the perennial irrigation to be done from the Bikaner Main Branch.

The irrigation done from the upper reach will be replaced by perennial irrigation from the tail of the Rori Chautala (A-9) tract distributaries.

The whole of the supply now utilized in the Northern Ghaggar Canal will then be available for use in the Southern Ghaggar Canal which can be increased in capacity and extended into the dry tract south of the Ghaggar Nala.

The construction of the Sutlej Dam Project, which involves the opening out of the drainage lines in the so-called Closed Drainage Tract and the abandonment of the pernicious system of bunding the drainages, together with the abolition of the Rangoi and Sarusti Canals, will materially improve the supply available at Otu.

Bikaner State contributed to the cost of these two canals and no objection by the State to the alterations proposed is likely to occur.

The development of the Southern Ghaggar Canal system does not form a part of this Project, the case can be dealt with separately when the time comes.

22. Absorption.

The usual rate of absorption heretofore assumed in all canal projects and actual working of canals has been 8 cusecs per million square feet of wetted area.

Though little experimental data properly tabulated existed in connection with this question since the Project Division was formed, two careful series of experiments have been carried out on the Sirhind Canal to determine the absorption under various conditions. The whole of the experimental results are given on the diagram D (Appendix G).

So far the information obtained appears to confirm the fact that the rate of absorption in the same reach varies with the depth of supply and that the rate of absorption varies with the class of soil through which the channel runs and the conditions of subsoil water level.

Two sets of observations have been made on the Main Line which from the diagram it is seen are wonderfully concordant. The observations on the Abohar Branch, however, are confined to one series, these are to be repeated and two similar series observed on the Bhatinda Branch. When these are completed it should be possible to arrive at definite conclusions regarding the branches.

Statement No. 1, page 54, shews the percentage of absorption on the existing Punjab Canals calculated from the statistics of water distribution taking averages of ten years. It will be seen that except for the figures of the Lower Jhelum Canal in the rabi the results are wonderfully constant and shew that about 1/6th of water passing the canal regulating gauges is lost *en route* to the distributary regulating gauges.

It is not strange that these results are so constant when one considers that all the canals dealt with are so similarly situated and proportioned.

It has not been possible to deal with the canals of the Triple Canal system as they have not been running a sufficient length of time to enable averages to be struck from the records over a sufficient number of years.

In column 12 of the statement under consideration the figures derived by Mr. Woods by calculation from his method are given. These differ but little from the results obtained by using the figure of 8 cusecs per million square feet of wetted perimeter and are slightly higher than those obtained from the statistics of actual working.

It is assumed throughout the Project that absorption losses on unlined channels will on the average be 8 cusecs per million square feet of wetted perimeter and in lined channels 2 cusecs per million.

From the statements accompanying the reports on the two canals (Volume III, page 132 and Volume IV, page 107), the following shows the absorption losses that are expected, and what might be expected if no lining were done :—

	Upper Sirhind Canal.	Lower Sirhind Canal.	Total of both Canals.
	Cusecs.	Cusecs.	Cusecs.
Rabi capacity	10,174	7,602	17,776
Absorption as designed	837	185	1,022
Percentage loss	8.2	2.4	2.44
Absorption if no lining done	1,657	1,448	3,105
Percentage loss	16.2	19.0	17.5
Absorption saved	820	963	1,783
Percentage saved	47.0	67.0	57.4

It is thus seen that the saving in absorption will be 1,783 cusecs on the system by lining the channels as proposed.

Statement 20 in the Report on the Upper Sirhind Canal, Volume IV, page 129, shows that certain lengths of existing channels are to be abandoned and the absorption in these will be saved as follows :—

Upper Sirhind—

Abohar and Bhatinda Branches	...	...	337 cusecs.
Sirsa Branch 10+86	...	...	96 "
Total	...	...	433

This is a very considerable saving and is an asset which should not be overlooked, being sufficient to raise the intensity of irrigation on the Bhatinda Branch, see columns 28 and 29, statement 5, in the report of the Upper Sirhind Canal, Volume IV.

23. Lining.

In dealing with the question of subsoil water level (paragraph 10) it has been shown that it is essential to line certain channels whether it is a paying proposition or not.

A note on the cost of cement which would justify its local manufacture on a large scale is attached (Appendix C-1) and paragraphs 3—6 deal with the expenditure per 100 sq. ft. of concrete lining to prevent percolation losses which would be justified on financial grounds.

From this it will be seen that an expenditure of Rs. 5 per 100 square feet would be permissible on the conditions postulated.

As, however, the market does not provide sufficient Portland Cement at any price for the work proposed, a thickness of 6" kankar lime concrete has been estimated for as given in Appendix D, page 123.

This lining will be laid at bed level so that the same supply can be run in a smaller channel, advantage being taken of the decrease in the coefficient of rugosity from .0225 of an earthen channel to .015, the value found in America to hold for lined channels.

The total length of channels to be lined is 227 canal miles, with a superficial area of 140 million square feet. The absorption saved is calculated to be the difference between 8 cusecs per million square feet of wetted area in the

larger earthen channels and 2 cusecs on the lined ones and amounts to 1,666 cusecs, distributed 820 cusecs on the Upper Sirhind and 846 on the Lower Sirhind, exclusive of channels in Bikaner.

The Bikaner Durbar will save about 117 cusecs on their branches at an estimated cost of about Rs. 27 lakhs on lining.

The difference in cost between lined and unlined channels is estimated to be Rs. 113 lakhs, for which 1,666 cusecs are saved or a rate of about Rs. 7,000 a cusec saved. This estimate is made as follows :—

(a) The total outlay on lining will be :—

Lower Sirhind, British	...	Rs. 154 lakhs
Upper Sirhind	...	„ 126 „
<hr/>		
Total	...	„ 280 „

(b) If the branches are lined, the cost of land, earthwork, bridges, etc., is estimated to be :—

Lower Sirhind, British	...	Rs. 108 lakhs.
Upper Sirhind	...	„ 59 „
<hr/>		
Total	...	„ 167 „

(c) The cost of the same items as (b) above for channels if not lined will be :—

Lower Sirhind	...	Rs. 202 lakhs.
Upper Sirhind	...	„ 132 „
<hr/>		
Total	...	„ 334 „

(d) The total of items (a) and (b) above is Rs. 417; from this item (c) should be deducted to obtain the net cost of the lining, viz., Rs. 113 lakhs.

There will be other savings such as those due to the ease and rapidity with which lining can be laid by machinery, the reduction in the labour force required to do the earthwork and the smaller size of mechanical excavators required, as it is proposed to use these to a great extent.

No attempt is made at this stage to lay down elaborate specifications for this work. The details of laying and materials to be used will be settled later after further investigation with possibly visits to America by Executive Engineers who will have to carry out the work in this country.

The estimated cost is based on the use of stone or kankar lime, but if cement could be produced in sufficient quantities and at a reasonable price, there is no reason why it should not replace the ordinary limes.

24. Lower Sirhind Canal.

The new headworks will be at Aliwal, 12½ miles below Phillour Railway Bridge.

The capacity of the canal at the head will be 9,259 cusecs in the kharif but in the rabi only 7,602 cusecs will be required. The details of the capacity of the canal are given in the report on the Lower Sirhind Canal, Volume III, Statement I, in diagrammatic form. Statements 2 to 6, give complete details of the capacities of the various channels. Statements 7 to 18 give in abstract tabular form all other information which has been collected concerning this canal. The Main Line, a concrete lined channel, at mile 6.8, will throw off the Grey Canal Feeder of a capacity of 1,000 cusecs to maintain the irrigation of the existing Grey Canals. The Main Line will end at mile 27.0 where it will meet the Abohar Branch below Daudhar Fall, mile 42.6. The Abohar Branch capacity of

2,417 cusecs for the rabi will remain unaltered but be increased to 3,074 cusecs in the kharif to supply the new areas of kharif irrigation proposed from the Sutlej Navigation channel.

From Daudhar the new canal will continue as the Abohar-Bhatinda Feeder, a lined channel, 25 miles, to the Bhatinda Branch, which it will meet at Dhipali, mile 58.5, the capacity of the branch being increased slightly to 1,200 cusecs to allow for an increase of intensity to 40 per cent. of Gross Commanded Area.

From Dhipali the canal will continue as the Phul Feeder, a lined channel, 6.2 miles, to the crossing of the Rajpura-Bhatinda Railway where it will bifurcate into the Rori Feeder 1,462 cusecs and the Bhatinda-Bikaner Feeder 2,307 cusecs.

The Rori (A-9) Feeder, a lined channel, will go straight for the highest point in the Rori-Chautala tract which it reaches near the village of Suratia at mile 34.4. This Feeder supplies all the distributaries to irrigate this area of 681,000 acres, which forms part of the Sirsa Tahsil, north of the Ghaggar, and a small area of Bikaner territory north of the Ghaggar and east of the drainage line which form the natural boundaries of irrigation in this tract.

The Bhatinda-Bikaner Feeder, 46.2 miles long, a lined channel, makes for the high corner of Bikaner near Dabwali where it bifurcates into two branches, the Main and the Border Branches.

The Main Branch, a lined channel, runs for 53 miles along the Jodhpur-Bikaner Railway, throwing off distributaries to irrigate the portion west of and including the Ghaggar, within the limits of command south of the drainage line forming the southern limit of the irrigation of the Border Branch.

The Border Branch, 8.8 miles long, will be a concrete lined channel ending on the British Border where it will feed distributaries for irrigating the remaining area in Bikaner north of the drainage line.

All details of alignment and works are given in Volume III, Chapter VI, of this Project.

25. The Grey Canals.

The eight Grey Inundation Canals taking off from the Sutlej above Ferozepore are most inefficient and a detailed report on these is given in Volume III, Chapter VI.

The Project only provides for a feeder channel from the Lower Sirhind Canal to link up and supply their heads. This will result in an assured supply being run in them from 1st May to 30th September, but will not remove the undesirable conditions caused by the fundamentally unsound alignments on which they run at present.

These canals are administered by the Civil Department with whom it rests to decide what action could be taken to remedy the evils when the Project is being carried out.

The question turns on whether the present irrigators who have, as it were, certain proprietary rights on these canals will give up their rights in return for properly aligned and designed channels for which they will pay the full water rates.

The agreements signed by all villages taking water from these canals clearly specified that they would have no claim against Government should their supply of water be refused or irrigation stopped (see paragraph 15 of the Record of Rights, Appendix D-11, page 173, of Volume III).

26. Bikaner State's contribution.

It is proposed that the Bikaner State pays the whole cost of all the branches, and distributaries in Bikaner as well as that of Bhatinda-Bikaner Feeder and *pro rata* on the share of the capacity of the rest of the Feeders

Main Line and Headworks of the Lower Sirhind Canal as worked out in statement 12 accompanying the report on the Lower Sirhind Canal, Volume III, and abstracted in the statement on the next page.

The total share of the cost of the Lower Sirhind Canal, including headworks debitable to the State, will be Rs. 2,71,12,790, which amounts to Rs. 27 per acre gross command on the State channels.

It is considered desirable that the whole cost of the Dam and Reservoir should be borne by the British Government so as to reserve to the Supreme Government or the Local Government as its representative entire control of the water therein and its distribution to suit conditions of the year. If the capital cost is pooled, all partners would claim distribution according to some agreement. The capital account for it should be kept entirely separate on commercial lines, the interest charges each year being added until the Project Estimate is closed.

On the completion of the Project Bikaner State would pay each year a sum to cover its share of the cost of the maintenance of the Dam and connected works as well as a share of the interest for the year on the capital cost of the same works.

The share of the charges to be paid by the State would be based on the proportion the stored water utilized by Bikaner bears to the total amount of the stored water utilized.

By this means a flexible method of payment would be obtained, which would provide against all unforeseen eventualities, and avoid difficulties likely to lead to technical quibbles, whilst leaving the control of the working of the reservoir in the hands of the Supreme Government.

For instance, if a definite quantity or share of stored water were allocated to Bikaner State it might very probably occur that the State might not desire to utilize as much or might desire more and the proposed method would put it within the power of the Government to meet their wishes, if feasible, thus benefiting both parties.

If the State during construction pays its contribution due annually from cash available in the State treasuries interest charges @ $5\frac{1}{2}$ per cent. amounting at the end of construction to Rs. 1,20,55,189 would be saved by them.

The total cost of the Dam is estimated to be 393 lakhs odd without accumulation of interest charges which would be another $\frac{634 \times 393}{1,441} = 172$ lakhs or a total capital of $393 + 172 = 565$ lakhs.

The annual interest at $5\frac{1}{2}$ per cent. on 565 lakhs will be Rs. 31,07,000 and allowing Rs. 1,93,000 for the mean annual maintenance charges Rs. 33,00,000 will be the annual cost of the Dam to be shared.

The rabi capacity share of Bikaner State on the Lower Sirhind is 2,341 cusecs (statement 12 referred to above) and the total increase in rabi capacity of the two systems is 9,276 cusecs. The Bikaner share would therefore ordinarily be $\frac{2,341 \times 100}{9,276} = 25.2$, say 25 per cent. Thus the State's probable annual contribution on the account of the Dam Storage would be 25 per cent. of Rs. 33 lakhs, or Rs. 8.25 lakhs per annum. If, however, money can be borrowed for construction of this scheme at a lower rate of interest, his figure will be correspondingly reduced.

Statement showing Bikaner Liabilities.

Lower Sirhind Canal, Main Canal and Branches, Direct and Indirect—

Rs

Total cost = 5,15,56,595

Bikaner share = 2,51,67,190 = 48.8 %

Lower Sirhind Canal, Headworks, Direct and Indirect—

Rs.

Total cost = 76,90,702

Bikaner share = 19,45,000 = 25.3 %

Rs.

Total cost of Lower Sirhind Canal system = 5,92,47,297

Bikaner share = 2,71,12,790 = 45.76 %

Total cost of Upper and Lower Sirhind and Western Jumna Canal systems—

Rs.

Lower Sirhind Canal = 5,92,47,297

Upper Sirhind Canal = 4,19,27,300

Western Jumna Canal = 19,25,839

Total = 10,51,00,436

Bikaner share = 2,71,12,790 = 25.8 say Rs. 26 %

Total including Dam = Rs. 10,51,00,436 + Rs. 3,03,74,490 =
Rs. 14,44,74,926.

Rs.

Bikaner share* = 2,71,12,790 = 18.76 say 19 %

Now total interest charges @ 4 % = 4,61,44,250

∴ Bikaner interest share @ 19 % = 87,67,407

and total interest charges @ 5½ % = 6,34,18,363

∴ Bikaner interest share @ 19 % = 1,20,55,189

Total Bikaner share = 2,71,12,790

Interest share @ 5½ % = 1,20,55,189

GRAND TOTAL = 3,91,67,979

* NOTE—Bikaner will not contribute to the capital cost of the Dam, but will only be responsible for the interest and maintenance charges on the total capital cost in proportion to the amount of stored water utilized each year from the Dam. The capital cost will include interest added yearly to the capital during the construction at the rate for the year.

27. Seigniorage from Bikaner.

The Phulkian States pay a seigniorage up to 1 annas per acre irrigated on the irrigation they should do—based on the supply utilized in the State Branches with duties obtained from the British Branches.

This figure of 4 annas when fixed was 10 per cent. of the mean water rate expected of Rs. 2-8-0 an acre.

It is unfortunate that this rate was definitely fixed at 4 annas and the fact overlooked that the value of water would increase in the future.

In the Sutlej Valley Project a seigniorage of 4 annas an acre was proposed for irrigation in Bikaner, but it is considered desirable that the old basis

of 10 per cent. of the mean water rate as seigniorage should be fixed, with suitable conditions to make it lighter in the first few years when irrigation is developing.

On the existing Sirhind Canal the seigniorage levied is on a sliding scale, depending on the percentage returns on capital of British Branches earned during the year. Therefore if expenditure on maintenance and development of the canal happens to be heavy and a low percentage results, an unsatisfactory low seigniorage only is leviable. Therefore seigniorage should be a fixed percentage of the mean water rate independent of financial results.

28. Financial Aspect of Irrigation in Bikaner.

Rs.

The total cost has been shown to be = 2,71,12,790

Interest charges at 5½ per cent. = 1,20,55,189

Total = 3,91,67,979

The capacity of distributaries supplied will be 2,247 cusecs. With a full supply factor of 212.5, the irrigation would be 477,487 acres, say 477,500 acres

Taking the total return of water rates and indirect revenue as Rs. 6 per acre and no credit for the sales of any Crown waste, the annual gross revenue would be :—

Rs 477,500 × Rs. 6	...	...	= Rs. 28,65,000
Deduct working expenses Re. 1 per acre which would include the share of maintenance of the Lower Sirhind Canal system	..	...	Rs. 4,77,500
Deduct share of the annual charges on account of storage 25 per cent. of Rs. 33 lakhs			8,25,000
Seigniorage 10 % of mean water rate	...	...	2,86,500
			<hr/> 15,89,000
			<hr/> 12,78,000

Taking no credit for any reduction of accumulated interest charges, the return on the capital would be $\frac{1,276 \times 100}{39,167} = 3.3$ per cent. Assuming that interest charges had been paid off, the return on the capital would be $\frac{1,276 \times 100}{21,112} = 6.1$ per cent.

There is no doubt that the State would get benefits from the sale of land for which no credit can be taken, while the pitch of the water rates could be fixed more in accordance with the value of the water than has been done in British territory.

The full supply factor adopted is that holding on the Sirhind Canal where kharif irrigation is low owing to the people being too prosperous to trouble to undertake hard work in the fields in the hot weather.

In a State where full powers are concentrated in the Ruler, modern commercial methods could be adopted of charging higher water rates in the rabi to villages which did not do a fair proportion of kharif irrigation.

There is therefore no doubt that Bikaner State will be able to make handsome profits out of their contribution account.

In the resolution of His Honour the Lieutenant-Governor on the Administration Report of the Irrigation Branch, Punjab, for the year 1917-18, it is pointed out that the mean value per acre of the crops irrigated was Rs. 39.54, say 40. This figure is based on the admittedly conservative rates of outturn and prices adopted by the Director of Land Records, but taking these figures the value of the crops expected would be $47,500 \times 40 = 191$ lakhs. The capital cost including interest charges will be Rs. 391 lakhs or Rs. 271 lakhs excluding interest charges, or in other words the value of the crops would pay for the capital invested in $2\frac{1}{2}$ or $1\frac{1}{2}$ years, respectively.

29. Sirhind Canal Agreement with the Phulkian States.

The agreement of 1873 (Appendix F 1, clause 40), reserves to the British Government the right to extend or alter the canal in any way it pleases on the understanding that the share of water first assigned to the States shall not be diminished.

In the project the maintenance of the existing rights of the States is provided for and their share of the water will under the new proposals be delivered into the off-take of the State channels from the new feeder instead of at Manpur, thereby giving the States the benefit of the absorption now lost between Manpur and the head of their branches.

The States will have to incur no capital expenditure in connection with the project except that they will be given the 60 cusecs at the head of the Ghaggar Branch for the irrigation of the British tract north of the Ghaggar and incur the costs in connection with the irrigation thereof, taking the revenue obtained in the same manner as is now done in the case of Budh-lada tract.

Owing to the increase in the capacity of the Main Line and the new feeder their share of the cost of maintenance will be decreased and there should be a considerable annual saving to them on that account.

The agreement fully covers all that is required to ensure the smooth working of arrangements in connection with the project. Land will be acquired under clauses 7, 22, 30 and 40 of the 1873 agreement.

30. Sirsa Branch Agreement with Patiala State.

When the Sirsa Branch was constructed it was intended to be a kharif channel only. By the time the completion report was submitted in 1896 it had been found that it was desirable to give the channel a perennial supply by taking water from the previously existing branches in the rabi rotational working.

As the supply to the Patiala distributaries was a fixed percentage of that in the branch, the State derived a great benefit at no extra expenditure and at the loss to the British Government of the income from the water given in the State channels in the rabi. Appendix H in the Completion Report shows that 48,640 acres of irrigation were annually expected in Patiala from the Sirsa Branch.

Under the Sutlej Dam Project the reach of the Sirsa Branch from which those distributaries are supplied will be transferred to the Upper Sirhind Canal and the rabi supply materially improved, the mean supply in the rabi being increased from .4 to .6 of the full capacity. This water will moreover be water stored at great expense.

The agreement (Appendix F-4) lays down the annual contribution to the maintenance of the Western Jumna Canal. These conditions will be entirely altered and the modification of the agreement will have to be undertaken.

It is possible that the State might be prepared to cancel the existing agreement, Government refunding them the capital sunk to date. The distributaries would then be worked the same as all the other British distributaries.

If the agreement be not cancelled, its revision will be exceedingly complicated and need very careful consideration to ensure that Government obtains a fair return on the capital sunk, which will benefit the supply and increase the irrigated area on these distributaries.

31. Agreements with Bikaner State.

The irrigation in Bikaner from the Bahadran Branch of the Western Jumna Canal was the subject of an agreement in 1911.

The Bahadran Branch which runs in the drainage will be abandoned and a greater area will be irrigated from the tails of the British distributaries which will be aligned on the ridges in this tract.

The State will probably only too readily accept the changes proposed under the project.

The Ghaggar Canals.—These inundation canals were constructed in 1897 and Bikaner contributed a share of the cost of both. The matter was the subject of an agreement in 1897.

The Northern Canal will be abandoned and the whole commanded area brought under perennial irrigation.

The Southern Canal will be enlarged to utilize the supply of the Northern Canal which will be set free and the increased supplies which it is anticipated will be available owing to the opening out of the Closed Drainage Tract higher up the Ghaggar and the abandonment of the inundation canals in the upper reaches.

It is not anticipated that there will be any difficulty with the State in making any modifications considered desirable when the time comes in the terms which now hold.

Sutlej Dam Project.—An agreement will have to be entered into with Bikaner, largely on the lines of the Sirhind Canal agreement with the Phulkian States, Appendix F-1, but amended clauses will need to be added with reference to the use of and contribution on account of the use of stored water. Reference to this is made in paragraph 26 regarding the contribution of Bikaner State.

32. Agreement with Jhind.

The agreement regarding the irrigation from the Western Jumna Canal is given as Appendix F-2.

All the irrigation to be given to the State under the Sutlej Dam Project will be done through British distributaries and no irrigation will be given under the terms of this agreement.

33. Design of distributaries.

The existing distributaries of the Sirhind Canal were remodelled from 1905 onwards on the basis of a 40 per cent. intensity of irrigation on the culturable commanded area and a full supply factor of 170 acres per cusec of capacity at distributary head.

There is a constant increase in the efficiency in the use of water and the full supply factor is continually rising.

It was however decided to design the distributaries on the new Sirhind system on the same data as that of the existing Sirhind Canal so as to obtain a uniformly designed system throughout.

On the Western Jumna Canal the distributaries were remodelled on a full supply factor of 150 acres; this is due to the fact that the mean supply available on that canal in the rabi is lower than on the Sirhind Canal. All the distributaries which will be supplied from the Western Jumna Canal are therefore designed on the same full supply factor of 150 acres.

The culturable commanded area has been taken as 90 per cent. of the gross commanded area in all cases. With a low intensity of 40 per cent. the question of the culturable commanded area does not come into question as there will be no distributaries on which there is not sufficient culturable commanded area to enable the irrigation proposed to be effected.

Having designed the distributaries on a uniform basis, the irrigation to be expected can be estimated from the full supply factor anticipated, which again will depend on the amount of water available in the rabi and the demand in the kharif.

34. Programme of Construction.

Details of the programme for the construction of the various portions of the scheme are given in the reports of the Bhakra Dam, Upper Sirhind and Lower Sirhind Canals. (Volume II, page 18, Volume IV, page 23, Volume III, page 34)

The project is based on a 12 years' programme and although certain portions are expected to be completed before that time, maintenance and interest charges and the financial statements are in all cases based on the full period.

Work in connection with the Dam will be started in the first year and it is hoped to have it completed to full storage by the 8th year, but in the 5th year some stored water will be available.

On the Lower Sirhind Canal a start will be made at once on the channels to irrigate the Rori A-9 tract, so that irrigation may commence by the 5th year. The headworks will be started in the 3rd year and the whole canal, it is hoped, will be completed by the 9th year.

The Upper Sirhind Canal will be commenced in the 3rd year and irrigation started in the 10th year, the whole being completed in the 12th year.

The work on the Western Jumna Canal will be started in the 1st year, as most of the work will have to be done in closures and the extensions must be complete in time to utilize the water set free in the Sirsa Branch in the 12th year.

35. Working Expenses.

The working expenses, it is thought, should not exceed one rupee per acre on a thoroughly up to date canal in which all modern requirements are foreseen and where the main channels are lined.

This was the figure adopted for the Upper Chenab Canal in the Triple Canal Project, the figure for the Lower Bari Doab being only 12 annas.

The figure on some of the older canals is above one rupee per acre, but this is due to the fact that the canals are being improved and modernised by expenditure under maintenance and repairs.

Further, it should be borne in mind that an appreciable amount of the new irrigation anticipated will be effected by increasing the supply in the distributaries of the existing Sirhind and Western Jumna Canals which will therefore not entail any extra expenditure on maintenance.

36. Establishment.

This has been estimated in accordance with the orders of the Government of India conveyed in Circular No. 1764-A of 1st November 1918.

The total provision of the whole Project amounts to Rs. 145 lakhs.

It is presumed that with the heavy construction work involved, requiring at least three new circles, a Chief Engineer and Secretary will be required.

Provision is made for —

Superintending Engineers —

Bhakra Dam.

Upper Sirhind Canal.

Lower Sirhind Canal.

On the completion of the project the necessity for the first two will cease and the existing Sirhind Canal Circle will administer the Upper Sirhind Canal. The portion of the existing Sirhind Canal supplied by the Lower Sirhind Canal, being absorbed in the Lower Sirhind Canal Circle.

The following Executive Divisions are provided for

Bhakra Dam.—Two temporary and one permanent.

Upper Sirhind Canal.—One temporary and three permanent. In addition the Hissar Division which consists of the Sirsa Branch will be transferred to this Circle when the Sirsa Branch is incorporated in this system.

Lower Sirhind Canal.—Two temporary, and four permanent. Of the four permanent Divisions two will be for the Bikaner State Branches and irrigation therefrom.

Western Jumna Canal.—No further Division will be required; two new Divisions have recently been added to this Circle.

The total requirements will therefore be—

Five temporary Divisions.

Eight permanent Divisions.

Three Sub-Divisions on the average will be required per Division or 15 temporary Sub-Divisions, 24 permanent Sub-Divisions.

A corresponding number of Upper and Lower Subordinate and clerical establishment will be required.

The length of temporary railways that will be required with the corresponding number of Railway Engines and Rolling Stock is far greater than has so far been dealt with in any irrigation project.

For railway lines of this length, fully stocked with the proper complement of Rolling Stock and running several trains a day over a period of many years it will be absolutely essential that a Railway Engineer, and Traffic and Loco Officers are borrowed from State Railways, giving them deputation allowance; and the whole system controlled by men trained to it and not by Irrigation Engineers untrained in railway work or casual employees picked up in the open market by advertisement. What sufficed for the small railway installations of the Triple Canal Project will never suffice for the Sutlej Dam Project Railways and to attempt to work the proposed complicated system of canal railways on lines found good enough in the past will lead to disaster.

37. Capital cost of the Project.

The statement overleaf gives a detailed abstract of the cost of the whole project, totalling to Rs. 14,44,74,926 excluding addition of interest charges.

The estimates for all works have been made out in detail. The rates have been fixed after careful consideration of what may be expected to hold at the time of construction in view of the continual and steady rise in prices of labour and materials.

Every endeavour has been made in designs and estimates to standardize and take advantage of the economies and increased speed of construction that are likely to follow such procedure.

The detailed heads of the estimates have been dealt with in the reports on the separate canals.

The cost of land is high as the main channels are to a great extent aligned through highly irrigated tracts which involves the introduction of the new sub-head for the cost of works to carry existing irrigation channels across the new canals.

The sub-head for lining is also a new one, introduced for the first time in this project and the matter is dealt with elsewhere.

The most marked feature of the Project is the provision of Rs. 205 lakhs for heavy Tools and Plant. This is due to the great lengths of railway line involved and the economies that result from having canal rolling stock to carry the large quantities of materials necessary for the execution of the Project.

Further, provision is made for a considerable amount of mechanical plant and labour saving devices.

It is contemplated that the greater part of the excavation of the main channels will be done by mechanical excavators and that the concrete lining will also be done by mechanical means.

proposed under Sutlej Dam Project.

SIRHIND CANAL SYSTEM.		WESTERN JUMNA CANAL EXTEN- SIONS.		Grand Total of the canals.	Bhakra Dam.	Total of the Project.	REMARKS.
Main Canal and Branches.	Total Upper Sirhind Canal system.	Main Canal and Branches.					
9	10	11	12	13	14	15	
Rs.	Rs.	Rs.	Rs.	Rs.	Rs.		
99,550	99,550	29,408	3,02,181	1,40,000	4,42,181		
7,43,153	7,43,153	32,110	49,23,391	28,55,987	76,79,373		
...	3,59,000	...	42,96,867	2,38,82,681	2,81,79,568		
5,48,678	5,48,673	62,616	17,14,427	...	17,11,427		
3,14,3-3	3,18,383	52,728	5,15,272	...	5,12,272		
23,50,782	23,50,782	...	25,16,728	...	25,11,723		
...	...	24,678	21,678	...	24,678		
17,94,850	17,94,850	1,75,882	36,80,507	20,000	37,10,507		
88,658	88,658	...	15,82,628	...	15,82,628		
...		
...	...	2,210	2,210	...	2,210		
1,00,000	1,00,000	...	2,10,000	...	2,10,000		
13,43,400	13,43,400	1,73,083	35,35,353	6,00,000	41,35,353		
60,14,172	60,14,172	6,36,393	1,32,68,393	...	1,32,68,393		
1,25,82,880	1,25,82,880	...	3,07,18,920	...	3,07,18,920		
1,31,930	1,31,930	10,776	3,76,551	1,00,000	4,76,551		
...		
3,70,580	3,70,580	23,035	8,64,043	8,00,000	16,64,043		
6,00,000	6,00,000	12,588	13,37,588	4,00,000	17,37,588		
40,000	40,000	...	1,10,000	...	1,10,000		
2,70,1,031	2,74,31,031	12,43,298	6,98,60,545	2,87,88,668	9,86,78,253		
53,54,100	53,54,100	20,32,167	1,24,78,017	...	1,24,78,017		
2,65,140	2,65,140	...	2,65,140	...	2,65,140		
52,59,124	52,59,124	...	1,80,17,233	{ 75,00,000 18,14,933	2,05,17,233 18,14,933		*Contingen- cies.
3,70,59,895	3,53,03,395	32,75,405	9,56,35,940	3,81,13,001	13,37,49,581		
45,55,123	45,97,123	3,03,055	1,14,76,817	30,49,083	1,45,25,405		
5,89,391	5,74,041	49,132	14,34,533	5,71,704	20,06,233		
2,50,000	2,50,000	1,12,000	8,62,000	1,00,000	9,62,000		
4,33,33,014	4,37,31,104	34,29,652	10,04,08,836	4,18,34,393	15,12,43,229		
-26,29,562	-25,29,562	-11,000	-5,19,619	-31,00,000	-86,19,619		
4,07,01,352	4,11,01,602	38,18,652	10,28,40,217	3,87,34,393	14,16,23,610		
1,82,107	1,82,100	52,150	6,04,534	2,19,226	8,17,760		
6,37,718	6,73,508	55,023	10,01,085	4,26,872	20,38,557		
8,14,813	8,25,695	1,07,187	22,11,219	6,30,097	28,51,316		
4,15,24,170	4,19,27,000	30,25,439	10,61,00,436	3,93,74,490	14,44,74,926		
...		

38. Financial Aspect.

This has been worked out assuming three rates of interest, 4 per cent., 5 per cent. and $5\frac{1}{2}$ per cent.

Each of these has again been worked out with two full supply factors of 170 and 212.5 acres.

Again two sets of revenue rates have been applied to each of the above, those first suggested by the Financial Commissioner and revised rates now proposed by this Department and now under his consideration.

This results in twelve different financial aspects as given in the statement below. The necessary forms arriving at this abstract are also ready, but it will only be necessary for the Local Government to utilize the forms applicable to the interest and rates finally adopted—

		RATES OF INTEREST ON CAPITAL.					
		4 per cent.		5 per cent.		$5\frac{1}{2}$ per cent.	
		Arrears of interest.	Per cent.	Arrears of interest.	Per cent.	Arrears of interest.	Per cent.
Full Supply Factor 170 acres on new Sutlej Storage Irrigation but	Financial Commissioner's present rates.	203 lakhs	4	456 lakhs	3.5	565 lakhs	3.3
Western Jumna Canal Full Supply Factor unchanged.	Revised rates proposed.	...	5.8	253 lakhs	4.9	364 lakhs	4.6
Full Supply Factor 212.5 acres on new Sutlej Storage Irrigation but	Financial Commissioner's present rates.	28 lakhs	5.5	281 lakhs	4.7	392 lakhs	4.4
Western Jumna Canal Full Supply Factor unchanged.	Revised rates proposed.	229 lakhs accumulated profits.	7.15	29 lakhs	7	141 lakhs	6.5

39. Acknowledgment of Services.

The staff employed in the Division has been considerable and consisted of the following officers :—Mr. F. C. Glass, Lala Shauqi Chand and Bhai Ishar Singh, Temporary Engineers, Lala Ganpat Rai and Lala Ajudhia Nath, Apprentice Engineers, who were in due course confirmed as Assistant Engineers.

In addition to the above were some 40 odd Upper and Lower Subordinates and Surveyors and the usual office staff.

Mr. Glass is due the credit of the field organization of the surveys which has resulted in such accurate results in the levelling, his former service in the Survey of India, combined with his previous experience in the carrying out as Executive Engineer of the Bikaner-Bahawalpur Surveys which bear his name, made him invaluable. It is only fair to say that although he was only attached to this Division as a Sub-Divisional Officer whereas he had previously been Executive Engineer in charge of surveys did not in the least affect the zeal or thoroughness with which he carried out his work or his keenness to give every assistance he could in the prosecution of the work in connection with the project. His touring in the Bikaner Desert and the Reservoir area were both extremely arduous, yet the difficulty was to get him to halt for a few days for work in the drawing office.

In 1917 he organised, trained and equipped the level survey party of 5 Surveyors and 40 Khallasies who left with Sheikh Minhaj-ud-din, Assistant Engineer, for Mesopotamia.

In May 1918, on the completion of the Field Survey in connection with the project, he received a Commission as Captain and left for Mesopotamia in charge of a Levelling and Survey party for the Irrigation Directorate where he now is.

If he does not return to the Punjab it will be a loss to the Irrigation Branch as he is unique in the Irrigation Branch in his qualifications for survey work and map production.

Lala Ajudhia Nath received a Commission as Lieutenant and went to Mesopotamia with Mr. Glass. He did excellent work in the field in the Sirsa-Bikaner surveys and in channel alignments and later on the Hydrographic Survey of the River Sutlej after the 1907 flood. His keenness and desire for efficiency stood out in pleasant relief.

Lala Ganpat Rai, Assistant Engineer, was in charge of the Phillaur-Jagraon and Patiala-Kaithal Surveys and showed himself to be a steady, conscientious worker.

Lala Shauqi Chand, Temporary Engineer, was in charge of a party in the Sirsa-Bikaner Survey doing well. Later after transfer he went to Mesopotamia to Mr. Glass.

Bhai Ishar Singh, Temporary Engineer, was in charge of a party on the Sirsa-Bikaner Survey, but failed to realize a sense of personal responsibility, he however was encouraged to go to Mesopotamia where it is believed he is now working well.

P. Amba Datta Joshi, Supervisor, was practically the whole time employed on double precise levelling in which he did exceedingly well.

The following Establishment also deserve mention for good work done in the order of merit in the various classes, those in *capitals* are worthy of special mention :—

Upper Subordinates—

Permanent.—L. Amrit Rai.

Temporary.—Fazal Hussain, Teja Singh, Kesho Singh.

Lower Subordinates—

Permanent.—MOHAMMAD QASIM, Gian Chand, Shadi Ram, Latif-ulla Khan and Harkaran Dass.

Temporary.—RAM KISHEN, BEHARI LAL, Uttam Chand.

Surveyors—

WALI MOHAMMAD, Mukand Lal, Alla Ditta, Amar Singh, Shadi Ram, Ganesh Das, Puran Singh, Ali Hassan, Amar Nath, Churanji Lal, Gian Singh, Kanshi Ram and Des Raj.

Draftsmen—

Permanent.—GHULAM MOHAY-UD-DIN, Head Draftsman, A. J. Mukarji, Din Mohammad, Mohammad Ali Khan and Abdul Majid.

Temporary.—Tracer Mohammad Sultan.

Clerks—

Permanent.—L. GANGA RAM, Head Clerk, Khuda Bux and Pindi Das.

Temporary.—Shabbir Hassan.

NOTE.—Men whose names are italicized went to Mesopotamia. In addition to the above 27 other men of the various classes worked, but are not considered worthy of mention.

40. Apologia.

The writer feels that he has been able to do but little justice to the Project in his reports in view of its magnitude of conception. He would however crave indulgence in view of the fact that since 1911 he has had under two months' leave, and that in 1918 when the Surveys were finished and the preparation of the Project estimate and report was put in hand, the necessity of the war became paramount, and from the staff employed in the Division, 87 Officers, Subordinates and men were recruited for Mesopotamia, the writer undertaking to finish the Project single-handed.

It is, however, believed that all the matter on which the Project is based and is incorporated therein is accurate and that an abler hand will be able to deal with the facts so as to convince any one reading his report of the absolute necessity of carrying irrigation into the tracts proposed which are so direly stricken, at the same time justifying the necessary expenditure.

H. W. NICHOLSON, B.Sc., A.M. J.O.E.,
Executive Engineer, Project Division, Sirhind Canal.

PUNJAB CANALS. Statement showing Percentage of Absorption on the Existing Punjab Canals.

Serial No. of Canals.	NAME OF CANALS.	3	4	5	MEAN DISCHARGE OF CROPS ON THE NUMBER OF DAYS IN CROPS.		8	9	10	11	12	REMARKS.
					Kharif	Rabi.						
1												
	Western Jumna Canal ...	6,480 (0.873)	...	...	3,319	2,823	543	10.4	438	16.7	Mr. Woods' value for full supply.	
	... { Canal		(85.9)	(18.1)								
	... { Distributaries ...	5,601	87.1	12.9	2,776	2,185					*14.0	The sanctioned capacity is 6,480 cusecs but the capacity required is 6,873 as shown within brackets.
	Sirhind Canal { (British Branches only 64 per cent. of 8,250 the mean sanctioned discharge of 10 years.)	5,280	84.2	15.8	2,142	2,555	317	14.8	37.5	14.7	20.3	* This figure is taken from the absorption in capacity statement of Western Jumna Canal, 1918, which is calculated at 6 cusecs per million square foot of irrigated area and at 8 cusecs per million square foot it comes to 18.6 per cent.
	... { Distributaries ...	4,446			1,885	2,315						
	Upper Bari Doab Canal ... { Canal	6,700	85.5	14.5	4,753	2,462	822	17.3	376	15.3	20.4	
	... { Distributaries	5,728			3,931	2,086						
	Lower Chenab Canal ... { Canal	10,780	84.9	15.1	7,885	7,197	1,348	17.1	1,188	16.4	18.5	
	... { Distributaries	9,107			6,587	6,014						
	Lower Jhelum Canal ... { Canal	3,900	85.4	14.6	2,759	2,930	489	15.9	338	11.5	10.7	
	... { Distributaries	3,331			2,320	2,592						

NOTE.—The values taken in column No. 12 are given in Appendix I of the Punjab Irrigation Branch Paper regarding absorption losses on Punjab Canals by Mr. Woods.

H. W. NICHOLSON, B. Sc., A. M. I.C.E.,

Executive Engineer, Project Division, Sirhind Canal.

Dated 14th March 1919.

PUNJAB CANALS.

Statement showing Area irrigated, Supply, Duty, etc., at Distributory Head Gauges.

Yrs.	AREA IRRIGATED IN ACRES.			NUMBER OF DAYS CANAL WAS IN FLOW.		Total authorised full supply of distributaries	DISCHARGE.		DUTY.		CAPACITY FACTOR.		FULL SUPPLY FACTOR.			
	Kharif.	Rabi.	Total.	Kharif.	Rabi.		Kharif.	Rabi.	Kharif.	Rabi.	Kharif.	Rabi.	Kharif.	Rabi.	Total.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
1905-10	389,308	342,080	731,388	165	174	5,563	2,855	2,318	136	154	51	40	70	62	122	
1910-15	371,566	396,076	767,643	170	169		3,169	2,469	117	160	55	44	66	70	136	
1905-10	219,654	418,955	638,609	183	182		2,948	2,269	126	175	53	40				
1910-15	289,401	571,289	860,690	163	169	Sindh Canal (existing British Branches only).										
1905-10	466,335	553,512	1,019,847	167	161	4,327	2,453	2,270	101	185	57	53	88	97	155	
1910-15	519,042	616,576	1,135,618	183	182	1,769	1,769	2,538	126	225	51	56	83	125	188	
1905-10	466,335	553,512	1,019,847	167	161	4,506	2,303	2,360	126	243	50	53				
1910-15	519,042	616,576	1,135,618	170	161	Upper Bari Doab Canal.										
1905-10	704,379	1,456,939	2,161,318	183	182	5,790	4,341	2,213	110	250	73	69	81	96	177	
1910-15	710,146	1,359,373	2,069,519	183	182	5,667	3,467	1,966	131	231	67	64	92	109	201	
1905-10	704,379	1,456,939	2,161,318	161	181	Lower Chenab Canal.										
1910-15	710,146	1,359,373	2,069,519	157	170	9,147	7,477	6,269	94	233	82	69	77	169	236	
1905-10	193,915	445,396	644,311	183	182	9,068	6,066	6,234	107	234	72	68				
1910-15	235,258	563,837	799,095	164	182	Lower Jhelum Canal.										
1905-10	193,915	445,396	644,311	174	164	3,290	2,235	2,636	89	168	63	81	60	135	195	
1910-15	235,258	563,837	799,095	183	182	3,331	2,104	2,402	94	185	64	73				
1905-10	193,915	445,396	644,311	164	164	3,331	2,586	3,059	91	184	77	69	78	173	250	
1910-15	235,258	563,837	799,095	183	182	3,331	2,320	2,692	101	217	70	78	71	169	240	

Dated 16th March 1919.

H. W. NICHOLSON, B. Sc., A.M.I.C.E.,
Executive Engineer, Project Division, Sirhind Canal.

WESTERN JUMNA CANAL.

Statement showing Area irrigated, Supply, Duty, etc., at Distributary Head Gauges.

Year.	Area irrigated in acres.			Number of days canal was in flow.		Total authorized full supply of distributaries.	Discharge.		Duty.		Capacity factor.		Full supply factor.		
	Kharif.	Rabi.	Total.	Kharif.	Rabi.		Kharif.	Rabi.	Kharif.	Rabi.	Kharif.	Rabi.	Kharif.	Rabi.	Total.
1	3	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1905-06	445,476	410,949	856,425	174 183	178 182	5,559	3,445 3,276	2,102 2,056	129 136	196 200	.03 .39	.38 .37	80	74	154
1906-07	449,480	402,822	851,762	171 183	159 182	5,569	3,085 2,879	2,897 2,531	145 156	139 159	.55 .52	.52 .45	81	73	153
1907-08	437,374	316,081	753,355	177 183	183	5,559	3,391 3,280	1,662	129 133	190	.61 .59	.30	79	57	136
1908-09	843,961	310,429	654,390	162 183	182	5,572	2,079 1,716	2,150	165 200	144	.37 .31	.39	62	50	118
1909-10	270,399	270,617	541,016	165 183	168 182	5,565	2,273 1,863	2,280 2,105	119 145	119 129	.41 .33	.21 .38	49	49	98
Five years' average	389,308	342,080	731,388	165 183	174 182	5,563	2,855 2,603	2,318 2,101	136 119	151 163	.51 .47	.40 .38	70	62	132
1910-11	278,458	306,980	585,438	160 183	148 182	5,576	2,400 2,098	2,840 2,310	116 132	108 133	.43 .37	.51 .41	50	55	105
1911-12	377,490	397,960	775,450	183	183	5,621	3,933	2,303	96	173	.70	.41	67	71	138
1912-13	350,808	471,533	822,341	173 183	182	5,639	2,892 2,785	2,607	121 128	181	.51 .48	.46	62	84	146
1913-14	413,610	366,529	779,139	163	182	5,699	3,153	1,818	131	202	.55	.32	72	61	136
1914-15	435,465	437,376	875,841	149 183	161 182	5,663	3,467 2,823	2,779 2,306	126 155	159 190	.61 .50	.49 .41	77	77	154
Five years' average	371,536	386,076	767,642	170 183	169 182	5,640	3,169 2,945	2,469 2,269	117 126	160 175	.56 .53	.44 .40	66	70	138

Dated 18th March 1919.

H. W. NICHOLSON, B.Sc., A.M.I.C.E.,
Executive Engineer, Project Division, Sirhind Canal.

SIRHIND CANAL EXISTING—TOTAL BRITISH BRANCHES.

Statement showing area irrigated, Supply, Duty, etc., at Distributory Head Gauges.

YEAR.	AREA IRRIGATED IN ACRES.			NUMBER OF DAYS CANAL WAS IN FLOW.		Total authorized full supply of Distributaries.	DISCHARGE.		DUTY.		CROPPIED FACTOR.		FULL SUPPLY FACTOR.		
	Kharif.	Rabi.	Total.	Kharif.	Rabi.		Kharif.	Rabi.	Kharif.	Rabi.	Kharif.	Rabi.	Kharif.	Total.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1905-06	282,862	476,116	753,008	139 183	182	3,998	3,603 2,736	2,725	79 103	175	90 68	48	71	119	190
1906-07	262,861	461,658	724,419	137 183	182	3,998	2,711 2,030	2,701	97 129	165	68 31	70	66	115	181
1907-08	250,791	537,510	788,301	131 183	182	4,541	2,169 1,553	2,138	116 161	251	49 34	47	57	118	173
1908-09	270,286	289,241	559,527	107 183	182	4,546	2,308 1,402	1,910	113 193	151	31 31	42	59	94	123
1909-10	181,170	330,331	511,491	114 183	183	4,549	1,336 1,125	1,787	118 161	185	34 25	39	10	73	113
Five years' average	249,531	418,935	63,519	130 183	182	4,327	2,183 1,769	2,270	100 141	191	37 41	53	58	97	155
1910-11	137,115	131,959	269,174	174 183	181	4,546	1,292 1,219	2,532 2,368	107 113	171 190	28 37	56 50	30	95	125
1911-12	297,850	754,733	1,052,582	182 193	181	4,546	2,378 2,265	2,804 2,878	131 171	261 262	30 60	64 63	67	106	211
1912-13	339,297	631,027	970,421	195 183	183	4,541	2,921 2,155	2,410 2,962	116 157	239 280	64 47	54 50	75	159	214
1913-14	314,328	578,141	892,809	165 183	182	4,595	2,572 2,419	2,343	122 153	247	56 60	51	68	126	191
1914-15	358,078	460,103	818,213	152 183	181	4,595	2,492 2,045	2,477 2,055	115 175	186 221	54 14	54 15	78	100	178
Five years' average	259,401	571,389	800,650	162 183	182	4,565	2,303 2,901	2,538 2,360	126 145	225 212	60 14	56 52	63	125	188

H. W. NICHOLSON, B. Sc., A.M.I.C.E.,
Executive Engineer, Project Division, Sirhind Canal.

UPPER-BARI DOAB CANAL.
Statement showing Area irrigated, Supply, Duty, etc., at Distributary Head Gauges.

Year.	Area irrigated in acres.			Number of days canal was in flow.		Total authorized fall supply of Distributaries.	Discharge.		Duty.		Capacity factor.		Full supply factor.		Remarks.
	Kharif.	Rabi.	Total.	Kharif.	Rabi.		Kharif.	Rabi.	Kharif.	Rabi.	Kharif.	Rabi.	Kharif.	Rabi.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1905-06	609,987	619,037	1,229,024	177 183	155 182	5,810	4,473 4,386	2,137 1,630	114 118	290 340	.77 .74	.37 .31	88	107	195
1906-07	417,510	621,283	1,038,793	178 183	149 182	5,806	3,863 3,757	2,588 2,119	108 111	240 293	.67 .65	.45 .37	72	107	179
1907-08	437,268	470,248	907,516	166 183	143	5,806	4,370 3,873	1,549	102 113	304	.74 .67	.27	75	81	156
1908-09	531,267	518,390	1,039,657	161 183	182	5,763	4,311 3,682	2,158	120 146	241	.75 .62	.37	90	90	180
1909-10	445,621	537,152	982,773	161 183	151 182	5,763	4,357 3,745	2,639 2,189	105 119	204 245	.74 .65	.46 .38	77	93	170
Five years' average	460,356	558,312	1,019,667	167 183	164 182	5,790	4,241 3,857	2,213 1,968	110 121	250 281	.73 .67	.38 .34	81	96	177
910-11	447,883	537,559	1,036,442	171 183	139 182	5,612	4,168 3,895	2,780 2,123	107 115	211 277	.74 .69	.50 .38	80	105	185
911-12	436,191	660,617	1,150,808	162 183	164 182	5,558	4,621 4,656	2,639 2,309	107 108	251 279	.83 .83	.47 .43	89	119	208
912-13	552,032	616,684	1,170,716	175 183	167 182	5,725	4,217 3,987	1,829 1,978	131 138	338 369	.74 .70	.32 .29	96	108	204
913-14	569,568	550,569	1,120,137	178 183	172 182	5,722	4,370 4,037	2,568 2,417	138 141	315 228	.75 .71	.45 .42	100	96	196
914-15	529,537	665,452	1,194,989	163 183	165 182	5,720	4,200 3,511	2,573 2,333	126 151	254 285	.73 .61	.45 .41	93	116	209
Five years' average	519,042	616,576	1,135,618	170 183	161 182	5,667	4,295 4,005	2,474 2,164	131 130	249 282	.76 .71	.44 .39	92	109	201

*Detail of capacity for 1916-17 according to Divisions therein.

Divisions	Total discharge	Kharif discharge	Rabi discharge
1st	100	540	100
2nd	1,562	110	7
3rd	2,152	...	...
4th	1,541	517	34
Total...	5,783	1,127	20

H. W. NICHOLSON, B.Sc., A.M.I.C.E.,
 Executive Engineer, Project Division, Sirhind Canal.

LOWER CHENAB CANAL.

Statement showing Area irrigated, Supply, Duty, etc., at Distributary Head Gauges.

Year.	Area irrigated in acres.			Number of days canal was in flow.		Total authorized supply of Distributaries.	Discharge.		Duty.		Capacity factor.		Full supply factor.		
	Area irrigated in acres.			Number of days canal was in flow.			Discharge.		Duty.		Capacity factor.		Full supply factor.		
	Kharif.	Rabi.	Total.	Kharif.	Rabi.		Kharif.	Rabi.	Kharif.	Rabi.	Kharif.	Rabi.	Kharif.	Rabi.	Total.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1905-06	749,829	1,402,001	2,150,830	172 183	182	9,549	7,891 7,417	6,624	95 101	212	83 78	69	78	147	225
1906-07	704,268	1,508,042	2,212,409	168 183	182	9,075	7,952 7,300	6,460	89 96	233	88 80	71	78	166	244
1907-08	663,020	1,380,659	2,043,679	167 183	183	9,037	7,393 6,717	5,542	90 98	249	82 75	61	73	153	228
1908-09	730,791	1,456,181	2,186,972	142 183	179 182	9,039	7,405 5,748	6,576 6,468	99 127	231 225	82 64	73 72	81	161	243
1909-10	674,889	1,337,810	2,012,699	158 183	180 182	9,036	6,743 5,822	6,146 6,077	100 116	230 233	75 64	68 67	75	170	245
Five years' average	704,379	1,456,939	2,161,318	161 183	181 182	9,147	7,477 6,606	6,269 6,234	94 107	233 234	82 72	69 63	77	159	236
1910-11	665,214	1,550,278	2,215,492	147 183	169 182	9,034	7,326 5,885	5,823 5,587	91 113	266 365	91 65	61 66	74	171	245
1911-12	710,931	1,623,159	2,334,090	171 183	182	9,440	7,480 6,990	6,613 5,923	95 102	246 274	83 77	73 66	79	180	259
1912-13	742,822	1,497,381	2,240,203	171 183	181 182	9,092	7,797 7,286	5,304 5,275	95 102	283 284	86 80	68 58	82	166	247
3-14	719,783	1,626,845	2,245,598	150 183	182	9,086	7,262 5,932	5,958	99 121	256	80 66	66	79	168	247
9-14-15	713,009	1,599,204	2,312,313	144 183	166 182	9,086	7,924 6,332	7,374 6,726	90 114	217 238	87 68	81 74	78	176	254
Five years' average	710,146	1,569,373	2,269,519	167 183	170 182	9,068	7,557 6,469	6,314 5,794	94 110	251 269	83 71	69 64	78	172	260

H. W. NICHOLSON, B.Sc., A.M.I.C.E.,
Executive Engineer, Project Division, Sirhind Canal.

LOWER JHELM CANAL.

Statement showing Area irrigated, Supply, Duty, etc., at Distributary Head Gauges.

Year	Area irrigated in acres.			Number of days canal was in flow.		Total authorized supply of Distributaries.	Discharge.		Duty.		Capacity factor.		Full supply factor.		
	Kharif	Rabi	Total	Kharif.	Rabi.		Kharif.	Rabi.	Kharif.	Rabi.	Kharif.	Rabi.	Kharif.	Rabi.	Total.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1905-06	99,697	310,903	410,600	182	161	3,295	1,815 1,803	1,965 1,736	55 53	177 200	55 53	80 53	30	105	135
1906-07	99,698	115,606	215,304	179	156	3,295	2,048 2,003	2,818 2,411	113 115	156 183	62 61	36 71	70	135	205
1907-08	201,985	153,592	355,577	180	183	3,295	2,498 2,438	2,967	82 83	153	73 71	90	61	138	199
1908-09	210,707	161,822	372,529	184	173	3,298	2,389 2,010	2,716 2,367	105 121	170 180	72 61	83 78	76	140	216
1909-10	212,400	519,999	732,399	173	160	3,298	2,407 2,375	2,780 2,296	88 93	180 226	73 69	81 70	64	167	231
Five years' average	198,915	115,596	314,511	174	161	3,296	2,327 2,104	2,656 2,403	89 91	168 185	68 64	81 73	80	135	195
1910-11	216,317	530,129	746,446	175	133	3,298	2,443 2,241	2,960 2,103	88 92	179 215	71 71	90 66	60	101	227
1911-12	232,030	567,619	799,649	175	166	3,298	2,616 2,602	3,079 2,808	88 93	184 202	81 76	93 85	70	172	242
1912-13	212,060	561,755	773,815	166	159	3,295	2,547 2,610	2,921 2,551	85 105	192 220	77 70	89 78	71	171	245
1913-14	211,653	578,579	790,232	164	149	3,308	2,672 2,219	3,289 2,093	92 100	176 215	79 67	98 80	73	172	245
1914-15	240,386	581,102	821,488	162	161	3,391	2,647 2,199	3,042 2,711	91 100	191 212	78 65	90 81	71	171	242
Five years' average	235,258	583,837	819,095	164	151	3,331	2,586 2,720	3,059 2,692	91 101	184 217	77 70	92 78	71	169	240

H. W. NICHOLSON, B.Sc., A.M.I.C.E.,

SIRHIND CANAL EXISTING.
Statement showing Area irrigated, Supply, Duty, etc., on Sirhind Canal Existing : whole Canal.
 [AT GARHI CANAL REGULATING GAUGE.]

Year.	Area irrigated in acres			Number of days canal was in flow.		Average supply.						Capacity factor.		Full supply factor			Remarks.		
	Kharif.	Rabi.	Total.	Kharif.	Rabi.	Entering Canal.		Excess.		Utilized.		Kharif.	Rabi.	Kharif.	Rabi.	Total			
						Kharif.	Rabi.	Kharif.	Rabi.	Kharif.	Rabi.								
1	3	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1905-06	432,601	752,063	1,184,664	139	182	0,445 1,805	1,079	181 137	40	0,264 4,768	4,719	69 91	159	78 59	59	51	94	148	
1906-07	440,157	757,525	1,197,682	137	182	5,119 3,856	5,176	207 155	115	4,932 3,700	5,061	89 119	170	62 16	63	35	95	150	
1907-08	385,078	804,105	1,189,183	131	183	5,326 3,313	4,384	278 199	11	5,048 3,614	4,373	76 107	164	63 45	55	18	101	149	
1908-09	407,189	512,000	919,189	107	182	5,832 3,110	4,268	161 57	111	5,681 3,352	4,157	73 133	123	71 41	52	51	64	115	
1909-10	285,847	524,595	810,442	134	183	3,950 2,923	4,011	458 335	133	3,632 2,586	3,878	81 111	135	44 32	48	30	66	102	
Five years' average	330,170	670,070	1,000,240	130	182	5,318 3,779	4,704	385 182	66	5,093 3,598	4,438	77 109	131	64 45	55	49	84	133	
1910-11	223,081	629,895	852,976	174	183	3,439 3,270	4,839	194 184	80 72	3,215 3,086	4,759	69 72	130 146	38 30	56 50	28	73	99	
1911-12	475,115	1,134,313	1,609,428	182	181	5,200 5,271	5,154	105 105	36	5,195 5,090	5,118	91 93	232	61 61	60	50	132	189	
1912-13	521,959	954,823	1,476,782	185	182	4,330 4,670	4,794	124 86	37 34	4,208 4,578	4,567	84 114	201 220	73 54	68 51	61	112	173	
1913-14	491,512	866,416	1,357,928	165	182	5,065 5,108	4,462	104 91	11	5,601 5,014	4,451	69 98	195	65 59	53	58	102	160	
1914-15	553,208	727,573	1,282,781	152	182	3,228 4,819	4,015	117 97	62 51	3,111 4,245	4,777	109 131	152 184	60 50	56 47	65	86	151	
Five years' average	453,331	800,701	1,314,032	162	182	5,102 4,632	4,818	129 113	46 40	5,054 4,418	4,772	89 103	180 193	60 52	56	63	101	151	
Ten years' average	421,782	705,387	1,127,169	145	182	5,270 4,156	4,693	192 147	55 39	5,078 4,007	4,605	83 105	166 173	62 49	56 51	61	93	144	Discharge = 8,225

H. W. NICHOLSON, B.Sc., A.M.I.C.E.,
 Executive Engineer, Project Division, Sirhind Canal.

SIRHIND CANAL EXISTING.
Statement showing Areas within irrigation limits (Commanded area) according to the Completion Report of the Canal.

Branches.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
		Gross area project, sq. miles.	Omitting Malar Kotla, sq. miles.	Final area Higham, sq. miles.	Subsequent changes, sq. miles.	Present gross area, acres and sq. miles.	90 per cent. of gross commanded area, acres.	Blue Book gross commanded area.	Blue Book culturable commanded area.	Irrigation 3 years.	Authorized supply in branches, a.ccs.	Supply per sq. mile.	Percentage of irrigation on present gross.	Percentage of irrigation on Blue Book gross.	Percentage on 90 per cent. gross commanded area.	Percentage on Blue Book culturable area.

A. Malukpur Rajpaha area transferred from Bhatinda Branch to Abobar Branch.
 B. Not taken up, being area between Bhatinda Branch and Feeder above Malar Kotla.
 C. Area north of Daudar left unirrigated.
 D. Area across Ghaggar included.

H. W. NICHOLSON, B.Sc., A.M.I.C.E.,
 Executive Engineer, Project Division, Sirhind Canal.

Dated 14th March 1919.

SIRHIND CANAL EXISTING.

Statement showing Duty, Capacity, Factor & Full Supply Factor of the system.

Serial No of channel.	Name of channel	Years	DUTY.		CAPACITY FACTOR		FULL SUPPLY FACTOR.		
			Kharif.	Rabi.	Kharif.	Rabi.	Kharif.	Rabi.	Total.
1	2	3	4	5	6	7	8	9	10
1	SIRHIND CANAL MAIN LINE. Discharge at Garhi Canal regulating gauge	5 years' average (1905—10) ...	109	151	15	55	49	81	133
		5 years' average (1910—15) ..	103	195	52	52	53	101	154
		10 years' average (1905—15) ...	105	173	49	54	51	93	144
2	NATIVE STATES BRANCHES Discharge at head of 1st Feeder (neglects absorption in main line)	5 years' average (1905—10) ...	105	145	44	56	46	81	127
		5 years' average (1910—15)	93	179	58	52	58	91	147
		10 years' average (1905—15) ...	96	161	50	51	49	86	137
3	BRITISH BRANCHES. Discharge at head of combined branch (neglects absorption in main line).	5 years' average (1905—10) ...	135	170	31	45	40	77	123
		5 years' average (1910—15) ...	119	215	41	49	53	104	157
		10 years' average (1905—15) ...	126	191	39	47	49	90	139
4	ADONAR BRANCH DISTRIBUTARIES Discharges measured at distributaries heads	5 years' average (1905—10) ...	147	191	48	53	63	103	166
		5 years' average (1910—15) ...	161	252	41	58	66	133	199
		10 years' average (1905—15) ...	149	224	43	53	61	119	183
5	BHATINDA BRANCH DISTRIBUTARIES. Discharges measured at distributaries heads.	5 years' average (1905—10) ...	131	170	38	51	50	87	137
		5 years' average (1910—15) ...	131	329	44	50	57	115	173
		10 years' average (1905—15) ...	131	199	41	51	51	101	155

NOTE—1. Duty \times Capacity Factor = Full Supply Factor.

2 The Capacity Factor is the proportion of the amount of water passed down the channel during the crop to the amount that would have passed down had it run full supply the whole time.

H. W. NICHOLSON, B.Sc., A.M.I.C.E.,
Executive Engineer, Project Division, Sirhind Canal.

SIRHIND CANAL—NATIVE STATE BRANCHES.

Statement showing Area irrigated, Supply, Duty, etc., on Native State Branches.
[ACTUAL DISCHARGE AT HEAD OF 1ST FEEDER (NEGLECTS ABSORPTION IN MAIN LINE)]

[ACTUAL DISCHARGE AT HEAD OF 1ST FEEDER (NEGLECTS ADDITION AT ...																	
YEAR.	AREA IRRIGATED IN ACRES.			NO. OF DAYS CANAL WAS IN FLOW.		AVERAGE SUPPLY.						DUTY OF SUPPLY UTILIZED.		CAPACITY FACTOR.		FULL SUPPLY FACTOR.	
	Kharif.	Rabi.	Total.	Kharif.	Rabi.	Entering Branches.		Escape.		Utilized.		Kharif.	Rabi.	Kharif.	Rabi.	Kharif.	Total.
						Kharif.	Rabi.	Kharif.	Rabi.	Kharif.	Rabi.						
1903-06	149,719	275,917	425,636	139 183	182	2,349 1,781	1,873	47 39	27	2,301 1,748	1,846	65 88	149	75 57	80	49	133
1904-07	177,326	295,987	473,313	137 193	182	1,991 1,491	2,009	49 37	40	1,942 1,464	1,969	91 122	150	63 47	64	58	154
1907-08	131,287	200,635	331,922	131 183	182	1,801 1,332	1,824	44 31	8	1,817 1,301	1,516	74 103	170	59 42	49	44	131
1908-09	130,913	212,769	343,682	107 183	182	1,841 1,076	1,757	92 64	30	1,749 1,012	1,727	78 134	129	57 33	58	44	116
1909-10	101,677	194,274	295,951	134 181	182	1,812 1,727	1,670	187 137	57	1,625 1,190	1,619	61 89	120	51 39	53	31	97
Five years' average	140,500	251,114	391,703	130 183	182	1,971 1,402	1,768	84 59	32	1,887 1,313	1,731	75 103	145	61 44	56	46	127
1910-11	85,686	188,406	274,092	171 183	182	1,204 1,517	1,887	55 52	33	1,541 1,405	1,551	53 58	102 111	50 49	60 54	28	89
1911-12	177,286	279,630	456,916	182 183	182	2,278 2,264	1,857	31 31	17	2,245 2,233	1,940	79 79	206 207	73 72	60 59	58	191
1912-13	182,662	323,791	506,453	175 183	182	2,248 1,658	1,983	60 44	20	2,198 1,911	1,683	97 113	195 211	71 53	54 59	59	164
1913-14	177,184	287,876	465,060	165 183	182	2,027 1,524	1,444	21 19	1	2,002 1,805	1,410	89 98	210	65 59	47	58	131
1914-15	107,130	207,408	314,538	152 183	182	2,045 1,690	1,961	49 38	26	1,980 1,653	1,935	90 119	139 167	65 64	63	64	151
Five years' average	103,090	289,416	392,506	162 183	182	2,048 1,701	1,767	43 37	21	1,993 1,754	1,715	83 93	168 179	65 58	57 52	53	147
Ten years' average	152,285	270,205	422,490	146 181	182	2,003 1,599	1,767	63 49	27	1,940 1,548	1,740	78 98	155 161	63 50	56 54	49	137

H. W. NICHOLSON, B.Sc., A.M.I.C.E.,
Executive Engineer, Project Division, Sirhind Canal.

SIRHIND CANAL—BRITISH BRANCHES.

Statement showing Area irrigated, Supply, Duty, etc., on British Branches.

[ACTUAL DISCHARGE AT HEAD OF COMBINED BRANCH (NEGLECTS ABSORPTION IN MAIN LINE).]

YEAR.	AREA IRRIGATED IN ACRES.			NUMBER OF DAYS CANAL WAS IN FLOW.			AVERAGE SUPPLY.						DUTY IN SUPPLY UTILIZED.		CAPACITY FACTOR.		FILL SUPPLY FACTOR.	
	Rabi.			Rabi.			Kharif.			Rabi.			Kharif.		Rabi.		Kharif.	
	Kharif.	Total.	Rabi.	Kharif.	Total.	Rabi.	Kharif.	Total.	Rabi.	Kharif.	Total.	Rabi.	Kharif.	Total.	Kharif.	Total.	Kharif.	Total.
1905-06	252,802	476,115	139	139	139	139	3,738	2,687	2,718	129	98	31	3,109	2,687	2,687	83	109	192
1906-07	262,861	461,358	137	137	137	137	2,747	2,019	2,777	143	111	90	2,549	1,908	2,687	104	138	172
1907-08	250,791	537,310	131	131	131	131	2,770	1,933	2,199	231	140	5	2,519	1,803	2,191	100	139	216
1908-09	270,290	289,241	107	107	107	107	3,000	1,754	2,371	332	191	90	2,668	1,560	2,181	101	173	132
1909-10	181,170	330,321	131	131	131	131	2,178	1,593	2,335	270	108	75	1,908	1,397	2,207	93	130	116
Five years' average	219,594	418,955	130	130	130	130	2,815	2,014	2,321	231	102	56	2,611	1,851	2,161	96	133	118
1910-11	187,145	331,989	174	174	174	174	1,813	1,732	2,952	139	11	11	1,701	2,910	2,910	81	166	170
1911-12	129,959	754,723	182	182	182	182	3,024	3,297	3,279	71	19	19	2,950	3,279	3,279	101	270	118
1912-13	339,297	671,027	135	135	135	135	3,527	2,614	2,737	61	17	17	3,191	2,710	2,710	97	230	116
1913-14	314,329	578,541	165	165	165	165	3,075	2,773	2,928	83	73	7	2,692	2,698	2,691	105	221	115
1914-15	335,978	460,103	152	152	152	152	2,890	2,402	2,770	71	59	30	2,819	2,731	2,731	137	168	108
Five years' average	289,101	571,289	162	162	162	162	2,478	2,513	2,981	86	24	24	2,792	2,837	2,837	104	210	119
Ten years' average	269,197	495,132	146	146	146	146	2,901	2,263	2,791	100	11	11	2,701	2,659	2,659	100	186	191

* Does not include main line absorption share.

H. W. NICHOLSON, B. Sc., A.M.I.C.E.,
Executive Engineer, Project Division, Sirhind Canal.

SIRHIND CANAL—ABOHAR BRANCH DISTRIBUTARIES.

Statement showing Area irrigated, Supply, Duty, etc., on Abohar Branch Distributaries.

[DISCHARGES MEASURED AT DISTRIBUTARY HEADS.]

Year.	Area irrigated in acres.			Number of days canal was in flow.		Authorized full supply Discharge.	Average supply utilized.		Duty.		Capacity factor.		Full supply factor.		
	Rabi.		Total.	Kharif.	Rabi.		Kharif.	Rabi.	Kharif.	Rabi.	Kharif.	Rabi.	Kharif.	Total.	
	Kharif.	3													4	5	6	7	8	9	10	11	12	13	14	15	16
1905-06	180,492	287,634	468,126	130 183	182	2,243	2,138 1,633	1,539	85 111	184	95 73	70	80	128	208
1906-07	161,964	278,514	440,478	137 183	182	2,243	1,578 1,161	1,365	103 137	178	70 53	70	72	124	196
1907-08	157,818	333,488	490,306	131 183	183	2,727	1,340 939	1,243	118 163	207	49 36	46	58	122	180
1908-09	178,783	189,492	368,275	107 183	182	2,727	1,569 917	1,214	114 195	156	58 34	45	60	69	135
1909-10	113,129	220,972	334,101	134 183	182	2,727	969 710	1,150	117 159	191	36 26	43	41	81	122
Five years' average	158,437	261,808	420,245	129 183	182	2,588	1,318 1,078	1,348	104 147	194	60 43	53	63	103	166
1910-11	93,497	298,273	386,770	174 183	182	2,727	813 773	1,072 1,498	115 121	175 195	30 27	61 35	34	108	142
1911-12	185,746	470,762	657,498	182 183	181	2,727	1,324 1,322	1,790 1,788	140 141	203 203	49 48	86 65	68	173	241
1912-13	208,069	397,329	605,398	135 183	182	2,727	1,726 1,273	1,391 1,284	121 163	286 309	63 47	61 47	70	146	222
1913-14	206,372	367,245	573,617	165 183	182	2,781	1,647 1,479	1,478	126 139	248	59 63	53	74	132	206
1914-15	217,786	297,360	515,096	152 183	181	2,781	1,443 1,109	1,460 1,203	151 182	205 248	52 43	52	78	107	185
Five years' average	182,284	365,192	547,676	163 183	182	2,748	1,389 1,269	1,556 1,460	131 161	235 232	61 44	56 53	66	133	199
Five years' average	170,360	313,500	483,860	145 183	175	2,640	1,464 1,114	1,452 1,399	117 149	210 224	56 43	55 53	64	119	183

H. W. NICHOLSON, B.Sc., A.M.I.C.E.,
Executive Engineer, Project Division, Sirhind Canal.

SIRHIND CANAL—BHATINDA BRANCH DISTRIBUTARIES.

Statement showing the Area irrigated, Supply, Duty, etc., on Bhatinda Branch Distributaries.

[DISCHARGES MEASURED AT DISTRIBUTARY HEADS.]

YEAR.	AREA IRRIGATED IN ACRES.			NUMBER OF DAYS CANAL WAS IN FLOW.		Authorized full supply of discharge.	AVERAGE SUPPLY UTILIZED.		DUTY.		CAPACITY FACTOR.		FULL SUPPLY FACTOR.		
	Kharif.	Rabi.	Total.	Kharif.	Rabi.		Kharif.	Rabi.	Kharif.	Rabi.	Kharif.	Rabi.	Kharif.	Rabi.	Total
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1906-06	161,505	187,785	349,290	139 183	182	1,755	{ 1,106 1,114 }	1,166 { }	69 91	161	{ 84 83 }	66	57	107	161
1906-07	100,206	180,919	281,125	137 183	182	1,755	{ 1,111 831 }	1,221 { }	90 120	118	{ 63 18 }	70	57	103	160
1907-08	92,093	201,838	293,931	137 183	183 182	{ 1,819 }	{ 829 593 }	895 { }	111 155	229	{ 46 33 }	49	51	113	161
1908-09	90,732	99,212	189,944	107 183	182	1,819	{ 829 181 }	696 { }	169 187	143	{ 16 27 }	38	50	55	165
1909-10	67,132	107,710	174,842	131 183	182	1,819	{ 507 415 }	628 { }	118 162	172	{ 31 23 }	35	37	59	96
Five years' average	90,334	150,699	241,033	130 183	182	1,793	{ 901 688 }	921 { }	91 131	170	{ 51 38 }	31	51	87	137
1910-11	43,185	135,454	178,639	174 183	163 182	{ 1,819 }	{ 469 446 }	860 770	92 97	158 176	{ 26 24 }	47 42	24	74	98
1911-12	109,251	277,162	386,413	182 183	181 182	{ 1,819 }	{ 931 933 }	1,104 1,098	114 { }	231 252	{ 32 52 }	61 60	60	152	212
1912-13	125,552	262,292	387,844	135 183	168 182	{ 1,814 }	{ 1,195 881 }	1,049 968	105 143	230 271	{ 86 49 }	58 53	69	145	214
1913-14	103,568	209,916	313,484	165 183	182	1,814	{ 931 830 }	868 { }	113 126	242	{ 51 46 }	48	58	116	174
1914-15	135,174	158,147	293,321	182 183	151 182	{ 1,814 }	{ 1,019 847 }	1,027 832	133 160	151 186	{ 56 47 }	57 47	75	87	162
Five years' average	103,906	208,574	312,480	163 183	169 182	{ 1,816 }	{ 914 793 }	982 911	114 131	214 229	{ 50 44 }	54 50	57	115	172
Ten years' average	97,070	182,336	279,407	146 183	175 182	{ 1,805 }	{ 937 741 }	951 916	104 131	192 199	{ 52 41 }	53 51	54	101	155

H. W. NICHOLSON, B.Sc., A.M.I.C.E.,
Executive Engineer, Project Division, Sirhind Canal.

Dated 18th March 1919.

Statement showing the relation between the total area irrigated on Western Jumna Canal and the water utilized at sowing time measured at Canal Regulating Gauge.

[FIGURES TAKEN FROM THE ANNUAL STATISTICAL RETURNS.]

Year.	Rabi crop.	WATER UTILIZED, CUSSEES DAYS.			DEPTH USED PFR ACRE.			RAINFALL, HISSAR DISTRICT, INCHES.			REMARKS.
		October.	October and November.	October to 15th December.	October.	October and November.	October to 15th December.	September.	October to December.	January to March.	
1	3	3	4	5	6	7	8	9	10	11	12
1899-10	270,617	118,514	215,773	259,098	0.88	1.39	1.91	5.19	0.96	0.86	Omitted in average as remodeling of Distributaries set back irrigation.
1910-11	306,980	92,097	220,026	271,523	0.80	1.44	1.77	2.93	0.55	2.18	
1911-12	397,960	93,465	182,405	215,051	0.47	0.92	1.48	3.53	1.34	1.75	
1912-13	471,533	157,710	262,210	301,753	0.67	1.11	1.28	1.18	0.46	1.25	
1913-14	306,529	86,214	151,743	192,820	0.47	0.83	1.00	0.96	0.48	0.20	
1914-15	437,376	109,508	232,561	278,457	0.50	1.06	1.27	3.23	0.61	3.37	
1915-16	463,803	135,525	224,752	259,955	0.38	0.97	1.12	1.45	0.31	0.17	
1916-17	480,544	75,573	223,021	292,841	0.31	0.95	1.18	1.73	1.31	0.17	
				Mean	0.50	0.97	1.13	2.01	0.75	1.13	
		Limits of	variation from the	Mean	+ 0.17	+ 0.14	+ 0.13	+ 1.52	+ 0.59	+ 0.62	
					- 0.19	- 0.13	- 0.15	- 1.05	- 0.44	- 0.96	

H. W. NICHOLSON, B.Sc., A.M.I.C.E.,
Executive Engineer, Project Division, Sirhind Canal.

Dated 12th April 1919.

Statement showing the working of the existing Sirhind and Western to which the changes will take place

Serial No. of items.	Items.	Source of information.	LOWER SIRHIND CANAL PROPOSED.		UPPER SIRHIND		
			SIRHIND CANAL EXISTING.				
			Abohar Branch below Dhaudhar at M. 43 Perennial Distributaries.	Bhatinda Branch below Dhipali at M. 50 Perennial Distributaries.	Abohar Branch head to Dhaudhar at M. 43 Perennial Distributaries.	Bhatinda Branch head to Dhipali at M. 50 Perennial Distributaries.	Abohar and Bhatinda Branches Kharif Distributaries.
1	2	3	4	5	6	7	8
1	Gross area within irrigation limit ...	S. Stat., 1912-13 ...	1,084,378	565,782	187,995	518,991	152,191
2	Culturable commanded area ...	S. Stat., 1912-13 ...	962,536	515,100	178,058	445,214	139,569
3	Area proposed to be irrigated ...	S. Stat., 1912-13 ...	410,850	171,820	60,800	121,740	15,330
4	Per cent. of culturable commanded area proposed to be irrigated in remodelling 1905	Remodelling records...	40%	33½%	40%	33½%	18½%
5	Per cent. of culturable commanded area on present working figures	Line 3 + line 2 average.	42%	33%	31%	27%	11%
6	Total area irrigated in both crops ...	S. Stat., 1911-14 ...	531,677	215,010	59,753	133,262	23,683
7	Percentage do. on G. C. R. ...	Line 6 + line 1 ...	49%	39%	32%	25%	18%
8	Percentage do. on C. C. A. ...	Line 6 + line 2 ...	55%	42%	34%	30%	17%
9	Area irrigated in kharif ...	S. Stat., average 1911-14.	172,372	67,307	19,218	44,790	10,211
10	Percentage do. on G. C. A. ...	Line 9 + line 1 ...	16%	12%	10%	9%	7%
11	Percentage do. on C. C. A. ...	Line 9 + line 2 ...	18%	13%	11%	10%	7%
12	Area irrigated in rabi ...	S. Stat., average 1911-14.	359,375	147,703	40,540	88,472	13,442
13	Percentage do. on G. C. A. ...	Line 12 + line 1 ...	33%	26%	23%	17%	10%
14	Percentage do. on C. C. R. ...	Line 12 + line 2 ...	37%	28%	23%	20%	10%
15	Proportion kharif, rabi irrigation ...	Line 9 : line 12 ...	1 : 2.08	1 : 2.19	1 : 2.11	1 : 1.97	1 : 1.31
16	Average No. of days canal ran, kharif ...	S. Stat., average 1911-14.	←	←	← 161	←	←
17	Ditto ditto rabi ...	S. Stat., average 1911-14.	←	←	← 177	←	←
18	Time factor kharif ...	Line 16 + 183 ...	←	←	← 85	←	←
19	Ditto rabi ...	Line 17 + 182 ...	←	←	← 97	←	←
20	F. S. Factor proposed when channels remodelled in 1905-08.	Remodelling records	←	←	← 170	←	←
21	F. S. Factor from present working figure	Line 3 + line 22 ...	185	163	220	170	62
22	Total sanctioned discharge of distributaries.	S. Stat., 1912-13 ...	2,218	1,051	277	716	215
23	Mean discharge on number of days kharif in crop.	S. Stat., average 1911-14.	1,161	516	120	359	87
24	Mean discharge on number of days rabi in crop.	S. Stat., average 1911-14.	1,316	566	170	396	27
25	Capacity factor, kharif ...	Line 23 + line 22 ...	52	49	40	50	35
26	Ditto rabi ...	Line 24 + line 22 ...	59	51	50	56	11
27	Duty, kharif ...	Line 9 + line 23 ...	146	130	160	125	116
28	Duty, rabi ...	Line 12 + line 24 ...	273	261	238	224	498
29	Full supply factor kharif ...	Line 9 + line 22 ...	78	64	70	63	41
30	Ditto rabi ...	Line 12 + line 22 ...	162	140	146	121	55
31	Ditto both crops	Line 29 + line 30 ...	240	201	216	187	96
32	Rainfall, mean 3 years, kharif	S. Stat., average 1911-14.	7.1	7.1	10.4	9.9	12.2
33	Ditto rabi	S. Stat., average 1911-14.	2.1	2.3	2.9	2.7	3.4

The 3rd February 1919.

Jumna Canals for the average of 3 years 1911-14 by sections according under the Sutlej Dam Project.

CANAL PROPOSED.		WESTERN JUMNA CANAL PROPOSED.								
		WESTERN JUMNA CANAL EXISTING								
Sirsa Branch.		Sirsa Branch	Hansi Branch.		Butana Branch.		Delhi Branch.		Main Branch.	
Below junction of Tolana Branch mile 85—tail.	Below junction of Sirsa Feeder miles 34—85	Above junction of Sirsa Feeder miles 0—30	Statistical Statement 1912.	1910 Capacity Statement	Statistical Statement 1912.	1910 Capacity Statement	Statistical Statement 1912	1910 Capacity Statement	Statistical Statement 1912	1910 Capacity Statement.
9	10	11	12	13	14	15	16	17	18	19
178 330	392 511	220,722	588,310	574 558	354,120	370,024	008,780	653 920	259,415	257,040
112,892	339,103	201,223	186,652	483,009	299,715	330,306	510,119	517,969	235,518	209,329
47 630	112 797	66,910	181,915	306,608	93,234	122,000	226,085	236,149	73,336	78,782
33½%	33½%	33½%	..	..	..	..	..	..	..	..
33%	33%	33%	37%	13%	31%	36%	12%	13%	31%	33%
01 023	133,021	68 301	210,301		79 288		167,161		57,092	
35%	34%	32%	37%	38%	22%	21%	27%	26%	21%	22%
43%	11%	31%	41%	15%	27%	23%	31%	31%	24%	27%
21,971	63,751	29,180	111,733		11,493		80,178		21,487	
12%	10%	13%	10%	20%	12%	11%	13%	12%	9%	9%
15%	19%	14%	23%	24%	14%	12%	16%	15%	10%	12%
39,619	69,270	39,181	111,071		37,793		86,983		32,614	
22%	18%	17%	17%	18%	11%	10%	14%	13%	13%	13%
23%	20%	19%	21%	21%	13%	11%	10%	10%	14%	16%
1 : 18	1 : 109	1 : 103	1 : 109		1 : 091		1 : 11		1 : 13	
...
139	115	163	138	171	142	149	142	110	168	149
344	778	445	1,313	1,207	658	820	1,588	1,022	465	530
191	458	210	986		381		783		263	
183	313	168	590		231		539		193	
55	59	49	76	82	51	16	49	48	57	50
53	44	35	45	49	34	27	34	33	41	36
115	189	138	116		109		112		93	
217	202	218	170		169		161		169	
64	86	60	87	95	68	61	50	49	53	46
105	93	88	77	81	57	46	55	51	70	61
170	179	164	164	179	120	97	105	103	123	107
82	110	148	108		135		115		173	
15	20	21	25		31		20		31	

H. W. NICHOLSON, B.Sc., A.M.I.C.E.,
Executive Engineer, Project Division, Sirhind Canal.

PART III.

PHYSICAL DESCRIPTION OF THE TRACT BETWEEN THE RIVERS JUMNA AND SUTLEJ COMING WITHIN THE SCOPE OF THE SUTLEJ DAM PROJECT AND HISTORY OF THE DEVELOPMENT OF IRRIGATION THEREIN BY Mr. H. W. NICHOLSON, EXECUTIVE ENGINEER.

1. The limits of the tract.—The tract is bounded on the west by the Sutlej, on the east by the Jumna and on the north by the Sewaliks. On the south the boundary from the Jumna to Bhadrán on the Chautang Nala is defined by the reverse slope rising to the Central Indian Table Land. From Bhadrán, westwards to the Bahawalpur border, the Chautang, a tributary of the Ghaggar, and the Ghaggar itself, below their junction, form the boundary.

South of these nalas the country rises and is covered with sandhills, making irrigation impossible. From the Ghaggar to the Sutlej the boundary of the tract is defined by sandhills and the limit of irrigation is fixed in Mr. Gibb's Sutlej Valley Project of 1917. The whole tract is the alluvial deposit of the Indo-Gangetic Plain at its divide.

2. The Drainages.—The drainage of the western portion of the Sewaliks as far east as the Siswan torrent passes into the Sutlej and the Indian Ocean. That of the eastern portion of the Sewaliks, as far west as the Somb Nala, drains into the Jumna and the Bay of Bengal. The central portion drains into the Ghaggar.

3. The tributaries of the Ghaggar on the right bank, after they have left the hills, are known as the Lissara, Sirhind, Choa and Patiala Nalas, but of these the Patiala Nala is the only one in which any water reaches the Ghaggar. The others now all die out before they reach the main drainage; their old courses are, however, clearly discernible on the contour plans and in parts are very well defined at site bearing the local names of "Wah". There is an old tradition that some day a ruler will come and make the nalas flow with water again, and the local people are satisfied that the time is now come when the saying will come true and that water will again flow through the tract by the construction of the Sutlej Dam Project. Their hopes were partially realised when the Sirhind Canal was constructed and the upper reaches were irrigated.

It is very noticeable that the courses of all these nalas, in the extinct reaches, are marked by the largest towns and villages. Throughout the Punjab ease in obtaining water has in the past fixed the sites of the larger villages along drainage lines.

4. The tributaries of the Ghaggar on its left bank are the Tangri, Umla, Markanda and Sarusti. The first three of these, all of which rise in the Sewaliks, have become most destructive in the last century. This is due to the deforestation of the Sewaliks owing to the former forests becoming village common lands. The villagers, having had no foresight, cut and sold the timber for fuel and unmercifully grazed any growth that existed.

The result of this deforestation has been that torrential rainfall, not being held up by vegetation, passed off for the most part as surface flow, instead of soaking into the ground. Also having less resistance to overcome, owing to the hills being bare, the velocity of flow increased, carrying away the surface soil. There was then no possibility of the vegetation re-establishing itself, and the rain that fell ran off with greater rapidity, causing intensified floods which possessed much greater erosive powers and carried forward coarser material than previously. With a coarser silt-charged the torrents, were unable to maintain their former régime, and as the slope of their beds flattened further from the foot of the hills, they silted up and the floods spread over the country. The coarser material which could not be carried in suspension was first deposited. The finer clay was deposited

Yes, but concurrently with these serious difficulties arising and the villages affected finding themselves unable to overcome them, expansion of irrigation in other parts of the Province taking place, attracted the people, who readily abandoned their own devastated tracts (from uncontrollable floods) and went as cultivators where controlled irrigation had begun.

(Sd.) H. W. M. IYER,
20-5-19.

further from the course of the Nala and thus formed the large stretches of Dakar soil which are such a marked feature of the "Closed Drainage Tract".

The flood water, having lost its silt charge, collected and formed ravines which developed into Nalas tributary to the Main Ghaggar. This action explains the trouble which now exists in the so-called "Closed Drainage Tract".

5. The Sarusti Nala differs from the other tributaries of the Ghaggar in that it has no catchment in the Sewaliks and is similar to the Rakshi and Chautang Nalas in this respect.

The Sarusti, Rakshi, and Chautang Nalas, unlike the others, have their catchment areas in the Plains.

(Sd) H. W. M. Ives.

20-5-19.

These three nalas only drain the ground rising towards the Sewaliks, and there is therefore little or no trouble on them due to coarse sand being eroded and brought down to upset their regime.

Any trouble on these three nalas due to flooding is caused by man putting in bunds to divert the water for irrigation. These bunds have silted up the natural channels, so when large floods occur the whole country is flooded as there is no natural outfall. The deposition of this fine clay makes a hard Dakar soil which is so difficult to cultivate.

6. The Rakshi Nala is a tributary of the Chautang Nala and the united flood of these two rarely goes further than the Sirsa Branch Crossing, although the Chautang Nala is clearly traceable as a drainage to Dhatrat whence to Bhadrin in Bikaner the Hansi Branch and the tail Distributary now run in its bed.

7. The Chautang in Bikaner.—Beyond Bhadrin, the Chautang Nala is very pronounced as a wide extinct river bed having a depth of 20 to 30 feet below the surrounding country. It is a matter of extreme interest to consider the conditions brought to light in the Sutlej Dam Project Surveys at the site where the extinct Chautang Nala meets the Ghaggar Nala.

The Chautang has a bed slope of 1 in 5,000 feet and its bed is fifteen feet below that of the Ghaggar at the junction. The Ghaggar above this point has a slope of 1 in 4,000 feet and downstream a slope of 1 in 4,500 feet.

There is a rise in the Chautang bed in its last three miles of fifteen feet as noted above. As the Ghaggar rose by silting, water flowed back up the Chautang bed which consequently silted up with a slope in the opposite direction to that of its natural course, thus showing that the Chautang ceased to flow for a considerable period before the Ghaggar dried up.

8. The Hakra.—The combined channel of the Chautang and Ghaggar lower down is known by the name of the Hakra and it is clearly traceable in Mr. Glass's Bahawalpur contour surveys to Khanpur. It is commonly supposed to have been an old bed of the Sutlej, and to have had its outfall into the Rann of Cutch through the now dry bed known as the Eastern Nara in Sindh. Surgeon-Major C. F. Oldham wrote an article (Notes on the lost River of the Indian Desert) in the Calcutta Review of 1874 which developed this theory.

A historical paragraph, and not relevant to the subject.

(Sd) H. W. M. Ives.

20-5-19.

From further information now available it appears that there is another more scientifically justified explanation, namely, that the old Chautang is the extinct bed of the Jumna river, and that the Hakra, when it ran as a river, was carrying what is now Jumna water.

The whole area between the Sutlej and the Jumna being alluvial, and the fact that the level of the alluvium near the Jumna is some 150 feet higher than that near the Sutlej, shows that that near the Jumna must have been deposited by the Jumna.

Now the water from which the alluvium was deposited must have flowed along the slope as indicated by the alluvium formed. Such being the case, it will be seen that a part or whole of the Jumna water, when depositing the alluvium, must have flowed off westward, that is, into the Chautang and Sarusti. These two channels are main tributaries of the Ghaggar and Hakra.

It is well known that when a river is depositing alluvium its channels in the upper reaches are unstable and sway from the ridge of the delta first to one side and then to the other. The Sutlej and Jumna Doab is the ridge or divide of the Indo-Gangetic Plain and to have formed such a ridge the river depositing the alluvium must have oscillated, falling off at one time into the Indus catchment and at another time into the Ganges catchment. The acceptance of this explanation accounts for the existence of the Hakra and Chautang, whereas, if it were accepted that the Hakra is the old bed of the Sutlej, there is no explanation of the cause of the existence of the Chautang. The Chautang is so big in its lower reaches, where it has not been obliterated by subsequent physical causes, that it is proof of previous physical conditions, the existence of which cannot be neglected.

The subsequent minor changes caused by the deposition of the silt through ages from the small catchment area left to supply these major drainages may, in the higher reaches, have somewhat masked this primary action locally, but in the lower reaches where this effect is absent the original conditions are much more definitely portrayed.

The Sarusti, or correctly in Sanskrit, Sarasvati — the river of pools — is one of the most famous rivers in Hindu mythology and the valley of the river is said to have been the original seat of Hindu learning. It is now held in great reverence and at Pehowa there is annually a great "mela". It is the tradition that the Sarusti never reaches the sea because it passes away underground and comes out again into the Ganges at Allahabad at its junction with the Jumna. The story quoted in support of this is that a man at Pehowa was bathing and lost his shoes and "lota" in the water. Later, when he went to Allahabad on a pilgrimage, he found the shoes and "lota" in the river there. At any rate the story is not without foundation because, when the Jumna avulsed from the Indus to the Ganges, the water that would have passed Pehowa on the Sarusti would then flow into the Ganges at Allahabad.

That the Jumna is flowing in a comparatively new course is shewn by the rate at which it is cutting down its bed in the alluvial plains. In the Etawah and Jalaun Districts the Jumna has cut its bed 120 to 200 feet below natural surface, and it is on record that the curb of a well in the fort at Shergarh near Auraya in the Etawah District in use in 1550 is now exposed in the river bank 60 feet above mean flood-level. It has also been stated that the bed of the Jumna at Agra is 30 feet lower than it was 350 years ago.

From the levels of the Rivers Sutlej and Jumna where they now break through the Sewaliks, it is seen that the Jumna is about 200 feet higher than the Sutlej, and from investigations made early in the last century it was noted that if the Jumna bed had been about 30 feet higher, that its water could have flowed by gravity into the Chautang Nala which was utilized as the bed of the old Ferozeshah Canal, about the source of supply of which so much discussion has taken place.

9. The Ferozeshah Canal.—From the time of the physical formation

A historical paragraph, but not relevant to the subject.

(Ed.) H. W. M. Ives.

20-5-19.

of the country the period of modern history is now reached for it was in 1351 A.D. that Ferozeshah Tughlak opened up the natural channel of the Chautang as a canal to Hissar.

In 156 this canal, having fallen into disuse, was again developed by Akbar, but it fell into disuse again by 1760.

10. Western Jumna Canal.—In 1817 the canal was again restored

A historical paragraph, but not relevant to the subject.

(Ed.) H. W. M. Ives.

20-5-19.

under British rule as the Western Jumna Canal (by Captain Blane, who is buried in Ludhiana) and water taken to Delhi and Hissar. The Durbah Branch beyond Hissar (shown on the maps as an abandoned canal and existing to this day) worked most satisfactorily for the first few years; but, as the demand in the higher reaches of the canal developed, there was not sufficient water left to reach the tail branch, so it was abandoned.

The development of the Western Jumna Canal caused such great trouble, owing to the increase in malarial fevers, that a Special Board was appointed to investigate the cause, and the spleen index as a measure of the malarial effect in the tract was first demonstrated by the medical officer attached to this Board.

In 1850 a proposal was made to take water in the kharif by a cut from the Western Jumna Canal to give an assured supply to the Ghaggar irrigation through the Sarusti Nala.

In 1873 the reconstruction of the Western Jumna Canal on scientific lines was undertaken and completed in 1891.

11. The Sirsa Branch designed as a kharif channel was begun in 1889 and irrigation commenced in 1892.

The Sirsa Branch was originally designed to have an intensity of only 20% and that only in the kharif with first watering for rabi crops thrown in.

(Sd.) H. W. M. IYER
20-5-19.

It was found to be unsatisfactory to work the branch as a kharif channel, as the rabi crops sown in the lower reaches could not be matured on a first watering only. The rabi supply to the

old channels on the canal was therefore shared with the Sirsa Branch to their mutual benefit, as the supply for the old channels was in excess of what could be efficiently utilized, and one cause of an accentuation of water-logging due to the rise in spring-levels was abated.

12. Extension from the Western Jumna Canal prior to 1900.—

Subsequent to the construction of the Sirsa Branch there has been further extension of distributaries into the high dry tract from the Hansi and Butana Branches, and in the famine year of 1900 the Nardak Distributary was added.

13. The Chautang Canal was constructed in 1899 by the Irrigation Department to utilize the flood water of the Chautang Nala below the Sirsa Branch. At the time the canal was proposed the idea was to drain the upper Chautang area between the North-Western Railway and the Sirsa Branch and to construct a canal system to give regulated flow for irrigation in that tract and to prevent the excessive flooding which took place owing to the drainage channels having been nearly obliterated by continual bunding. The surplus water made available was to be utilized in the Chautang Canal below the Sirsa Branch.

The Chautang Canal has failed to fulfil its purpose as the drainage of the upper Chautang tract was never carried into effect. The result is that it is only in years of excessive rainfall that any water crosses the Sirsa Branch and in such years there is no demand for irrigation as rain has then fallen in sufficient quantities over the tract commanded by the canal.

Subsequently it has been found necessary to supply the Chautang Canal

Water is never surplus in the Sirsa Branch except when there is no demand due to rain, and such occurrences are very rare.

with water from the Sirsa Branch of the Western Jumna Canal when there is water available. At the same time as the Chautang, two other similar canals were also proposed.

(Sd.) H. W. M. IYER
20-5-19.

14. The Markanda Canal was to take off from the Markanda below Ismailabad and above Kanthala, and irrigate the tract between the Ghaggar and Sarusti, including the Andarwar assessment circle of the Karnal District. This proposal was never carried into effect.

15. The Sarusti Canal was constructed in 1895-96 to the designs of the Irrigation Department by the District Board of Karnal. It is supplied from the old Sansa Jhil which is fed by the Sarusti and Markanda. A bund was built across the downstream end of the Jhil to form a reservoir which controls and stores the floods. Its capacity is such that the canal, which has a head discharge of 470 cusecs, runs about 20 days before it empties the reservoir and then runs dry itself.

The Jhil has been reclaimed by the silt deposit, and, at the end of the monsoon, when the canal has drawn off the water, valuable crops are grown in the bed of the reservoir.

16. The Rangoi Canal takes out of the Ghaggar just below Tohana. Its history is long and complicated. It was originally the Choya or Joya Nala, which is an old bed of the Ghaggar running past Fatehabad and to the south of Sirsa, where it is joined by the present bed of the Ghaggar.

The reports by Captains Brown and Baker on "Projected Canals in the Delhi territory, 1841-42" contain detailed surveys of the Ghaggar and Choya, and it is interesting to note that the surveys done in connection with the Sutlej Dam Project shew that the Ghaggar since then has lowered its bed some 6 feet for many miles near the off-take of this channel. Selections from the records of the Financial Commissioner, Punjab, No. 19, No. XLVII, Choya Dams, 1874, are interesting papers in connection with this canal.

The printed files of the Department of Revenue and Agriculture, 1911, give the further history of this canal. It had been managed by the Canal Department for many years until it was handed over to the Hissar District Board in 1912.

From the Ghaggar there were other small canals which in former times took off water towards Sirsa, but which have now fallen out of use.

17. The Ghaggar Canals were constructed in the 1897 famine by the Irrigation Branch. A bund with a masonry weir was built at Otu near Sirsa to hold up the Ghaggar floods. Two canals take off, one on each bank, and irrigate the bed of the Ghaggar and the land in its vicinity down as far as Hanumangarh in Bikaner. This was a modern execution of proposals made in 1840 to construct several such reservoirs in the Ghaggar which would have the advantage of not only storing water in such a dry tract, but also of raising the spring-level, thereby making well irrigation possible in time. The effect of the Otu reservoir is very marked, spring-level having risen from 200 feet to a normal depth of 20 to 30 feet.

The canals have not been satisfactory as the floods in the Ghaggar are so uncertain, being nil in a year of drought. The canal does not pay on paper, as a great part of the area irrigated pays no water-rate.

18. The Chandigarh Canals from the Ghaggar.—Where the Ghaggar Nala comes out of the hills, it has a perennial discharge. Some canals take out near Chandigarh in British territory and cause the renownedly unhealthy Chandigarh Muli, regarding which it has been recorded in the report on malaria in the Punjab, 1914, that "So surely as a man sleeps a night on the side of the road between Chandigarh and the Ghaggar in September so surely will he contract malaria". These canals appear to have existed as long as the country has been inhabited.

19. Patiala State irrigation from the Ghaggar.—Where the Ghaggar enters Patiala State, the Banur Canal takes off. Its distributaries cross the North-Western Railway and irrigate down as far as Bahadurgarh near Patiala City. Under the Sirhind Canal Agreement, 1873 with Patiala, the British Government have the right to take 20 cusecs out of the Ghaggar to supply Ambala Cantonments. (Para 42 page 213 appendix F-1.)

Irrigation from all the nalas in the lower reaches is carried out by bunding and flooding the country. In 1904, the Patiala State at an expense of Rs. 42,000 put a masonry weir across the Ghaggar south-east of Patiala to spread the Ghaggar floods over the country. This question of bunding is only touched on here. It is a complicated matter which is dealt with under the Closed Drainage Tract, page 82, paragraph 41.

The solution for the Closed Drainage Tract is the proper draining of the flooded areas and concurrently with this the introduction of properly controlled irrigation.

(Sd.) H. W. M. IYRS.

20-5-19.

20. Mirza Koondee Canals from the Sutlej.—All the canals from the Jumna and the Ghaggar have now been dealt with and only those in connection with the Sutlej remain to be considered.

Captain Baker submitted a report dated 24th September 1841 on the practicability of drawing water from the Sutlej for the irrigation of the tracts of land constituting the Bhuttee territory and the north-western parts of the Hissar District.

He pointed out the existence of the canal constructed in the reign of Mohammad Shah (probably IV, A. D. 1719) by Mirza Koondee, the Sooba of Sirhind. This canal took off from the River Sutlej just above Bharatgarh and crossed the Sirsa torrent and the Husseinpur torrent near Rupar, at both of which places the old masonry aqueducts still exist. The aqueduct for the Siawan Nala near the village of Balsanda was stated by the villagers to exist also, but it was silted over so badly that Captain Baker was unable to discover it.

Traces of the earthwork of the old canal remain, especially the notable cutting through the Rupar hill and beyond the Siawan Nala crossing. From this latter point the alignment of the channel is still well defined up to Sirhind and is shewn on the Survey of India Maps.

21. Captain Baker's 1st Project for the Sirhind Canal.—Captain Baker proposed to renew this canal and to deliver water at the tail of the main line at Sangrur into two branches, one leading into the Hissar District, 40 miles in length and the second leading to Abohar, 100 miles in length. It should be noted that the proposal was then to take the water to the most remote tracts where it was most needed, whereas later projects that matured aimed at building the cheapest canal to utilize the water available, a very different policy.

22. Changes in the hill torrents.—A perusal of Captain Baker's report incidentally draws one's attention to the great change that has taken place in the torrents draining the foothills. The Sirsa, which had previously had a width of 300 feet, had increased to half a mile by 1841 and now by 1918 it has increased still further. The same remarks apply to the Siawan, Budki and Sugh torrents. These changes are entirely due to the deforestation of the hills and documentary evidence is given in support of what generally has been accepted on the evidence of local tradition. In 1915 the reforestation of the Sewaliks in this tract was begun, and it is to be hoped that the work having been commenced will be carried through so that the desired result may be attained.

23. Canals from Tihara and the Ghaggar.—Captain Baker drew attention to the old Sukha Nadi which took off the Sutlej just below Sidhwan near new Tihara. It shewed signs of having been used as an irrigating channel from the number of water-courses which took off from it and irrigated up to Ferozepore. These had, however, fallen into disuse for many years. He proposed to take off a canal at the head of the Sukha Nadi, and shewed that it could work round the contours of the country and deliver water at Dabwali. Considering the Ghaggar as a source of supply, he proposed to end the canal from the Sutlej near Tihara at Malaut, and to bring a canal from the Ghaggar at Munak to Malaut, irrigating the whole of the area south of the alignment and north of the Ghaggar.

24. The Bhuttee area.—In those days the territorial boundaries in this tract, the whole of which is now proposed to be irrigated by the Sutlej Dam Project, were not defined. The land was considered to be so useless that no one worried much about ownership or boundaries.

At that time the famine of 1783 had so depopulated the country that

The Bhakra Dam Project in a similar manner aims at irrigating the remote tracts first, including on its way the improvement of irrigation in tracts its channels must pass through to get to the remote tracts.

(8d.) H. W. M. IYER.

20-5-19.

Captains Baker and Brown were both impressed by the necessity for irrigating the remote tracts first as being most in need of irrigation and where deficiency of rainfall is the rule rather than the exception. Furthermore they were strongly impressed by the desirability of introducing canals which would provide drinking water necessary for life apart from their requirement for irrigation.

It might not be out of place to note that in this year of "Scarcity" 1919 (famine not having been declared to exist by Government) water is being sold in the remoter portions of the tract at five scers to the rupee, that is to say, water which is usually assumed to be a free commodity; and yet a necessary costs as much as wheat flour.

25. Captain Dyas's 2nd Project for the Sirhind Canal.—In 1856 Captain Dyas undertook further investigations regarding the proposal to take a perennial canal off the Sutlej above Rupar.

26. Captain Crofton's 3rd Project for the Sirhind Canal.—After the 1860-61 famine, in 1862 Captain Crofton prepared and submitted a complete project at the request of the Maharaja of Patiala, who defrayed the entire cost of the surveys.

The canal was to have its head near Kiratpur and run to near Morindah, where it bifurcated. The Nirwana Branch was to run past Patiala across the Ghaggar to Nirwana with an extension indicated beyond Fatehabad. A central branch was proposed along the alignment of what is now the Ghaggar Branch of the Sirhind Canal and a Kotla Branch approximately followed the alignment of the branch constructed of the same name, with an extension proposed to irrigate the Sirsa Tahsil north of the Ghaggar, which so far remains unirrigated. A Ludhiana Branch was indicated as being possible which would carry water down to Abohar.

This project of 1862 by Captain Crofton was submitted to the Government of India with two memoranda by Col. Dyas, one dated 1862 before Captain Crofton commenced work, and the other after Captain Crofton had submitted a preliminary report.

27. Government of India's orders on 3rd Project for the Sirhind Canal.—In resolution No. 7—I, of 15th February 1867, the Government of India, before passing orders, asked that the opinion of Colonel Dyas might be obtained on the following points :—

- (1) On what he would consider the best mode of utilizing the waters of the Sutlej, irrespective of territorial divisions ?
- (2) Whether he would not advise a greater concentration of irrigation at a smaller distance from the canal head ?
- (3) Whether the capacity of the canals should be limited to that necessary for carrying the minimum supply, or whether it would not be preferable that they should partake to some extent of the nature of the inundation canals ?

Colonel Dyas, in dealing with the points, referred to his original opinion given in the memoranda submitted with the project :—

" In fine, I am of opinion that Captain Crofton's project for the irrigation of Patiala can scarcely be improved upon, but I also think that it would probably be worth while to ascertain whether a less expensive canal could not be made from the Sutlej River for the irrigation of British Territory."

" Looking, as an engineer, merely at the question of the employment for irrigation of the water of any river, and assuming that no special reasons exist for irrigating any particular tract, I am of opinion that the best line for a canal is that from which the largest extent of country can be irrigated at the smallest cost, irrespective of the name or nature of the existing Government of the country in question."

" If a larger extent of Patiala, than of British, territory can be irrigated from the Sutlej with the same quantity of water at a smaller cost, it would appear to me that the Sutlej was intended for the irrigation of Patiala, and I would run the canal accordingly."

" Governments are always liable to change, but a properly made canal will endure for centuries, if not for all time, and every Government is equally interested in its maintenance."

Colonel Dyas was of opinion that the first two questions could not be settled on the information available and that further surveys would be required.

The case was considered peculiar in respect of the third point as " between the Sutlej and the Jumna the land under command gradually passes into the great western desert, and all the water that can be thrown into that dry thirsty tract will tend to extend the cultivation and diminish the desert. This subject was specially noticed in the old reports of 1841."

28. Final 4th Project for the Sirhind Canal.—Further surveys were accordingly put in hand and a project was submitted for sanction in 1869 to the Government of India to cover the cost of the main line of the project only, so that work could be started while the remainder of the project for the branches was under preparation.

Work was started by the Government of India in anticipation of sanction. The estimate for the main line was sanctioned by the Secretary of State in his despatch No. 76, of 30th September 1870.

Paragraph 5 of the despatch reads :—

“ The just and liberal view that you have taken, with reference to the benefit to be derived from the canal works by Native States, is undoubtedly correct in principle. The scheme will be the best that can be devised, irrespective of territorial boundaries, as was strongly urged by the late Colonel Dyas ; and the Patiala State, while receiving a supply of water in proportion to the area of its land within the influence of the canal, will be expected to pay a fair proportion of the cost. There seems to be every reason to believe that suitable arrangements will be made with the Patiala and other minor Native States which will share in the benefit of the canal, and that your negotiations will be brought to a satisfactory conclusion.”

29. Construction of Sirhind Canal.—The construction of the Sirhind Canal took a considerably longer time than contemplated, owing to difficulties met with on the main line where the spring-level was in places 25 feet above canal bed. The large Siswan and Budki torrents had to be carried across the main line on aqueducts and considerable difficulty was encountered in connection with their foundations.

The canal was formally opened in 1882 with due ceremony at an expenditure of Rs. 67,514, which was charged against the amount of Rs. 70,000 provided in the project.

The canal was deemed to fulfil the conditions laid down by the Government of India in 1865—

“ That the only project which should be entertained by the Government of India is the best that can be devised, irrespective of the territorial boundaries of the British and Foreign States, and in the benefits of which the Native States should be allowed to participate in like terms with our own subjects.”

30. Limits of irrigation from the Sirhind Canal.—Irrigation was provided for within boundaries which did not extend up to the limits of command. The boundary on the west was the Danda or junction between the high lands and the khadir of the Sutlej and on the east the Patiala Nala, a tributary of the Ghaggar, and the Ghaggar itself until it left Patiala State. On the south the limit of irrigation was the Patiala State boundary west of the Ghaggar up to near Dabwali, where it cut across to the Bikaner boundary, which formed the limit of irrigation west of the point.

These limits were fixed as being simple ones to include an area which could be efficiently irrigated with the supplies available in the river. An intensity of irrigation of 20 per cent. of the gross area only was expected. This, however, has greatly increased with the advance of irrigation engineering.

31. Grey Canals.—In 1874 the Grey Canals, which are inundation canals in the khadir of the Ferozepore District, were commenced by Colonel Grey. Ten of the canals were completed by 1875, *viz.*, the Aghawah, Daulatwah, Bacherwah, Mayawah, Butewah, Jalalwah, Nizamwah, Khanwah, Panjehwah and Mubarikwah. In 1880 the Qutabwah and Barneswah were added. Later in 1883 the Fazilwah and in 1897 the Ilahiwah were constructed. In 1917 the Kingwah Canal was constructed with a head in the Ludhiana District near Sidhwan.

These fifteen canals have a total capacity of 5,328 cusecs, and are what Colonel Grey meant them to be, *viz.*, the most economical makeshift arrangements to throw the water of the river over a greater area of khadir lands to enable irrigated crops to be raised.

32. Irrigation Commission.—The above brings up to date the history of canals constructed, but there has never been an abandonment of the desire to push the limits of irrigation further afield into the more remote and less favourably situated tracts to mitigate the dire results of drought and famine.

The next step is marked by the foresight of Lord Curzon in arranging for the Irrigation Commission of 1901-03 to advise the Government of India on the possible development of irrigation.

33. Insecurity of tracts to be irrigated.—In considering the Punjab, the Commission divided the districts of the Province into three classes and gave an index number to each district to indicate the insecurity.

The whole area affected by the Sutlej Dam Project whether on existing channels or on new tracts into which irrigation is proposed to be taken, comes under the "Insecure" class. The two districts of Hissar and Rohtak, in which the greater part of the irrigation proposed under the Sutlej Dam Project is to be done, have the lowest index number, viz., Rohtak 26 and Hissar 16. The fact was also recorded that these two districts were undoubtedly the most insecure tracts in the Province, but the prospects of giving them complete protection against famine were not promising.

34. Extensions from the Western Jumna Canal.—The proposals considered by the Commission in connection with the extension of the Western Jumna Canal irrigation into the Hissar and Rohtak Districts were :—

- I. To reduce the intensity of irrigation on the older channels of the canal, where it was higher and to utilize the water thus set free for extension. The Commission did not consider that the information available was sufficient to justify their giving an opinion on the desirability of this proposal.
- II. To make subsidiary headworks lower down the Jumna and draw off an increased supply into the Western Jumna Canal in the kharif.

Regarding this proposal, the Commission stated "We find that the Jumna differs from all other Punjab rivers in the short duration of its flood supply. It is doubtful whether a supplementary supply would be available for more than 2 months in the year, and this would be of little use".

- III. To reduce the Eastern Jumna Canal's share of the cold weather supply in the Jumna.

Regarding this, they found that, although the southern districts of the Punjab were in greater need of irrigation than tracts that might be served by extensions of the Eastern Jumna Canal, yet the Agra Canal depended for its cold weather supply on the surplus water not only of the Eastern Jumna Canal, but also of the Ganges Canal, which is passed into it *via* the Hindun. Therefore no reduction in the Eastern Jumna Canal share could be made to permit of any material extension of irrigation on the Western Jumna Canal.

The Commission further recorded the suggestion which was made that the Eastern Jumna Canal should be fed from the Ganges, the supply in this river being supplemented by water drawn from the Sarda River. The water set free from the Eastern Jumna Canal would have enabled material extensions of irrigation in Hissar and Rohtak.

Regarding this, their opinion is recorded :—

"The value of a project by which such results may be attained in these districts will be very inadequately represented by the direct monetary returns."

This proposal was later worked up into a complete project as the Sarda-Ganges-Jumna Feeder Project of 1910 by Mr. Ward. It was prepared in alternative.

35. Sarda-Ganges Larger Project.—The larger project was to bring a feeder channel from the Sarda-Ganges Project across the river Jumna into the Main Branch of the Western Jumna Canal near Karnal to give an average annual supply of 1,400 cusecs.

Under this project there was sufficient supply to increase the intensity of irrigation on all the Western Jumna Canal distributaries up to 33½ per cent. of the commanded area and carry out the :—

- I. The Beri Bhalaut and Pai Rohana extensions from the Delhi Branch.
- II. The Tosham extension from the Butana Branch.
- III. The Barwala extension south of the Sirsa Branch.
- IV. The Tohana-Rangoi extension north of the Sirsa Branch.

Mr. Gordon, Chief Engineer, modified the project slightly as to cost, and, including the cost of the Sarda-Ganges Feeder, found the total cost would be Rs. 2,06,94,055, or Rs. ₹9.1 per acre irrigated.

36. Sarda-Ganges Lesser Project.—In the lesser project the Western Jumna Canal at the head would be increased by an average annual supply of 816 cusecs, made available from the Eastern Jumna Canal by the Sarda-Ganges Project of the United Provinces, which was to feed the lower reaches of the Eastern Jumna Canal.

This project provided for all the extensions proposed under the larger project with the exception of the large area of the Tohana-Rangoi No. 1V above.

Mr. Gordon, Chief Engineer, found the total cost would be Rs. 1,04,64,341, or Rs. 51.3 per acre irrigated.

37. Action taken on the Sarda-Ganges Project.—These projects were forwarded by the Local Government with their No. 702-W.I., dated 12th February 1912, to the Government of India for orders, but the case appears to have remained in abeyance pending the decision of the Government of India regarding the utilization of the waters of the Sarda River in the United Provinces.

The Punjab Government has since given up all claim to help from the Sarda-Ganges-Jumna Scheme.

(Ed.) H. W. M. IYRS,
20-5-19.

In any case, the Western Jumna Canal can always be benefited by water being set free in the Jumna at Tajewala from the Eastern Jumna Canal, as the rabi mean supply factor of the Western Jumna Canal is extremely low, being on 10 years' average only 0.41 of the head capacity of the canal.

38. Storage and waterproofing.—The Commission noted two other suggestions for increasing the cold weather supply available in the Western Jumna and other canals :—

- I. The construction of storage reservoirs in the Hills.
- II. The puddling of canal channels and village water-courses.

The Commission were pessimistic about the feasibility of storage reservoirs on the Jumna, but recorded the fact that they considered that the question of puddling channels deserved careful consideration. They referred to the practice in America of lining channels and stated :—

“At the same time we strongly recommend that systematic observations be made, on a considerable scale, of the loss by percolation in channels of all sizes and classes and that, when this has been determined, money should be freely allotted for the experimental lining of many of them for the purpose of determining the most effective and economical form of lining, and the saving of water that may be effected thereby.”

Since the Irrigation Commission sat, great advances have been made in the United States of America by the Reclamation Service. High dams which were then not considered possible are now frequently made, and large canals are lined with concrete. It is an American practice that the Sutlej Dam Project is based.

39. Koch Dam Project.—A project for a storage reservoir on the Jumna was worked up by Mr. Schönemann, but it was found that the most suitable site was devoid of any satisfactory material for a foundation.

40. Extensions from the Sirhind Canal.—Regarding the tract irrigable by extensions from the Sirhind Canal, the Commission considered that the extension of distributaries in the long belt of land between the existing Sirhind Canal limit of irrigation and the Sutlej Khadir was possible, but that protection was not urgently required. Furthermore, a large portion of this area came within the limits of command of the left bank canal from the Sutlej at Harike then proposed.

It may here be noted that the Sirhind Canal included this area in the commanded area of the British Branches at the time of construction, but that, in preference to constructing distributaries in this area, more water was allocated to the distributaries constructed in the remaining area of command of the Abbar Branch.

The Commission considered the extension of irrigation into the portion of the Hissar District north of the Ghaggar from the State Branches of the Sirhind Canal, but noted that the whole supply of the Native State Branches was utilized.

41. Closed Drainage Tract.—Regarding the remaining area coming within the limits of the Sutlej Dam Project, the Commission, in chapter XIV, paragraphs 57 and 80 of their report, dealt with the drainages in the Karnal and Ambala Districts and recommended that the question of ameliorating the conditions of the tract should be taken up.

A special division of the Western Jumna Canal was constituted for two years, 1914—16, to consider this question, but the matter was dropped as the Sutlej Dam Project materially affected a great portion of the tract. There was no great benefit to be obtained in developing proposals which would be liable to be changed in accordance with the decision arrived at regarding the Sutlej Dam Project.

See note dated March 1919 by Mr. H. W. M. Ives, with H. H. Sir Michael O'Dwyer's remarks thereon, which is added as Appendix A-2 at the end of this Volume.

(5a) H. W. M. Ives.
25-5-19.

42. Sarusti Canal.—Regarding the Sarusti Canal, the Commission recorded, "The Karnal District Board has constructed the Sarusti Canal, which of itself may prove a profitable work; but it is one which for many reasons a District Board should not have been called upon to take up." This canal will be absorbed in the Sutlej Dam Project.

43. Ferozepore Inundation Canals.—Regarding these, the Commission in chapter XIV, paragraphs 30 and 31 of their report, agreed with Colonel Grey's opinion "that the days of inundation irrigation have passed," and considered that they would be supplied from above weirs which would be built for perennial canals, "an arrangement which would increase their efficiency, though it would probably involve a change in the method of their administration".

Under the Sutlej Dam Project the eight upper canals will be given a controlled supply by a feeder from the Lower Sirhind Canal.

44. Ghaggar Canals.—Regarding these, the Commission recorded the fact that they were constructed by famine labour in 1896-97, and it was never expected that they would be remunerative as the supply is very precarious.

Under the Sutlej Dam Project the Northern Ghaggar Canal will be abolished and the whole supply of that river now shared by the two canals will be turned into the Southern Ghaggar Canal. The opening up of the Closed Drainage Tract and the possibility of supplementing the supply by water from the Sutlej Dam Project will greatly improve the future irrigation prospects of this canal and possible extensions therefrom.

45. Irrigation in Hissar from the Beas.—The Irrigation Commission in volume XIV, paragraph 80, their last paragraph on the Punjab, suggested the extension of purely kharif irrigation from the Sirhind and Western Jumna Canals in Hissar as possible famine relief works.

In the evidence given before the Commission, it is of interest to see that Mr. G. M. Field, Chief Engineer, had broad views as to the utilization of the Beas waters for the tract east of the Sutlej.

He pointed out that it was possible to put a weir in the River Beas near Nowshera and carry Beas water into the Sutlej above a weir at Phillaur. From this point a canal could be constructed to take up the irrigation of the Abohar Branch below Akhara (mile 42) and that of the Bhatinda Branch below Dhipali (mile 60). The water thus set free in the Sirhind Canal, he indicated, could be utilized in part for the irrigation of the portion of the Hissar District north of the Ghaggar by passing an increased supply down the Kotla Branch. The remainder, he shewed, could be carried across from Patiala to the Sirsa Branch near Kaithal and thence to the Hansi Branch at Jind. The water made available on the Western Jumna Canal could be utilized in the Butana Branch for irrigation in Hissar and Rohtak.

The above proposal was based on the pre-supposition that the Beas water was not required elsewhere in preference. Taking the Bhakra Dam reservoir on the Sutlej as the source of supply in place of the diverted waters of the Beas, it is extremely interesting to note how nearly in principle his proposals for the utilization of the supply fall in with what has resulted from the elaboration of this project.

46. Extension of irrigation in the Sutlej Valley.—As a result of the labours of the Irrigation Commission, the Government of India in their No. 1646-C.W.I., dated 24th November 1903, called for the opinion of the Local Government on the policy that should be followed, with reference to irrigation works in the Sutlej Valley.

47. Sir John Benton's opinion.—After further correspondence Mr. (now Sir John) Benton, then Chief Engineer, Irrigation Branch, Punjab, penned his note dated 6th July 1905 on "The utilization of the cold weather surplus waters of the Sutlej River".

In paragraph 38 he summarised his view, and the following sub-paragraphs are quoted as bearing directly on the tract dealt with under the Sutlej Dam Project :—

- I. "That constructing a canal from the Beas with off-take at Nowshera and crossing the Jullundur District the Sutlej River and the Sirhind Canal irrigation tract to the Hissar District is not advisable on account of the great length, the great loss by percolation, the poverty of results and the depriving of States and Districts with river frontage of a due share of the supply."
- II. "That the Sutlej River between Rupar and Ferozepore is the proper source of supply for the Hissar District, a kharif supply only being aimed at."
- III. "That a very small portion of Bikaner will be commanded by an off-take from the Sutlej at Ferozepore, and none from any point south of that; that Bikaner be allowed a supply for such part of the State as is commanded."

As a certain area of Bikaner State will be irrigated under the Sutlej Dam Project, it is interesting to note that Sir John Benton at one time advocated a supply being given to that State. See paragraph 9 of the note under reference.

48. Mr. Kennedy's opinion.—Mr. Kennedy, Chief Engineer, in a memorandum dated 28th August 1905, dealt with the case of the utilization of the Sutlej waters in which he differed from the views of Mr. (now Sir John) Benton as expressed in his note cited above. It was in this memorandum that he gave the numbering to the various tracts, which in the case of A-3 remains to this day as a short name for the tract of the Hissar District lying north of the Ghaggar, or what in this project is known as the Rori-Chautala tract. The tracts actually coming within the limits of the Sutlej Dam Project are :—

A-4.—A portion of Faridkot State not irrigated from the Sirhind Canal.

A-5.—The Grey Canals area.

- A-8.—The tail portion of the area irrigated from the Abohar Branch.
 A-9.—The Rori-Chautala tract of the Hissar District.
 A-11.—The portion of Bikaner between the Naiwala and the Ghaggar Nala.
 A-13.—The Patiala-Kaithal tract as far as the Sarusti Nala.
 A-14.—The tract between the Sarusti Nala and the limit of irrigation from the Sirsa Branch of the Western Jumna Canal.
 A-15.—The Patiala tract between the Ghaggar and the irrigation limit of the Sirsa Branch.
 A-16.—The tract of Hissar District between the Ghaggar and the irrigation limit of the Sirsa Branch, since generally known as the Tohana-Rangoi tract.

Mr. Kennedy stated that a scheme had already been taken in hand to send a supply down the Sirhind Canal *via* the Kotla Branch to irrigate A-9, but he proposed to modify this arrangement by taking a branch from the Bhatinda Branch at the head of the Phul Distributary to irrigate it.

The supply for the A-9 tract would become available by the construction of a canal from Harike, irrigating tract A-8, thus setting free the capacity required for A-9, about 1,200 cusecs. Tracts A-4 and A-5 would also be irrigated by this canal.

The supply which would have had to be brought down the Sirhind Canal for A-9 under the first proposal could then be taken past Patiala to irrigate tracts A-13, A-14, A-15 and A-16, regarding which tracts the Local Government and the Government of India had ruled that their state was such as to warrant a large unproductive expenditure.

With regard to the amelioration of the condition of the tracts irrigable south of the Sirsa Branch, he stated: "I am afraid we must trust to the chance of getting the whole of the Jumna water, as I agree with Mr. Benton that it is out of the question to bring a supply across the Jullundur Doab from the Beas."

49. Mr. Preston's opinion.—Mr. Preston, Secretary to the Government of India, in a note dated 27th September 1905, also recorded his opinion regarding the case. The first part of his note chiefly dealt with the areas without the limits of the Sutlej Dam Project. Regarding tract A-13, he stated there was no evidence to show that it required irrigation, and that it was a matter for consideration whether tracts A-14, A-15 and A-16 could not be more suitably irrigated from the Jumna.

He then dealt with the aspect of the Sarada-Ganges Project of the United Provinces, and the possibility of transferring the water across the Jumna River by a separate weir to serve the lower portion of the Western Jumna Canal, thus setting water free for the Sirsa Branch for the irrigation of the A-14, A-15 and A-16 tracts. If the proposal outlined was not feasible, then he accepted Mr. Kennedy's proposals for these tracts as sound.

Regarding tract A-9, in his paragraph 16, he stated: "It is a matter of detail whether tract A-9 can be better served by an enlargement of the Phul Distributary of the Bhatinda (British) or from the Kotla (Native States) Branch of the Sirhind Canal. There are obvious advantages in the former, and this would be quite possible if A-8 were irrigated from the new canal B. F. T. (*i.e.*, canal from Harike). It is hardly necessary to record that A-9 is in most urgent need of irrigation."

50. Sir Louis Tupper's opinion.—Sir Louis Tupper, Financial Commissioner, in a note dated 24th October 1905, reviewed the case, and the following remarks by him have direct bearing on the area within the limits of the Sutlej Dam Project:—

Paragraph 3.—"I submit that the situation of the Imperial Government coming forward to construct canals for the benefit of Native States is an entirely new one, altogether unknown to our predecessors and unlikely to have been created by them; and that there can be no historical foundation for any abstract

and wholly theoretical claim such as that suggested. A claim, however, based on the admitted fact that irrigation has been long practised by the State from the boundary river rests on an entirely different foundation, viz., that of common justice. In executing new schemes for the general good of the country no one, I imagine, would suggest that existing interests, whether of States or of individuals, should be damaged without compensation."

Paragraph 4.—"Subject to the above admission, as likely to be operative in the case, the view I take is that we should frame the projects for utilizing the Sutlej water eastwards without any regard to boundaries between British and State territory. The projects should be framed in the general interests of all alike, whether British subjects or ruling chiefs or subjects of ruling chiefs. The canals should be scientifically aligned so that the best use may be made of the water. No shares should be admitted on any *a priori* system. When the projects are completed, it will be known how many cusecs will go to Bahawalpur, how many to Bikaner, how many to British Territory. These will be the shares determined by the paramount power in the exercise of its paramount authority. It will be observed that my view applies to the Indian Empire, including Native States, the principles on which we already act in the construction of canals in British Territories. And, in the impossibility of any customs to the contrary dating from the days of the Delhi Empire, it seems to me that the incorporation of the States in the Empire entirely justifies my view."

Paragraph 8.—"I agree that the proposals for the Ghaggar and Sarusti tracts really form a separate case and should be so treated; but, if the Chief Engineer is appointed for these schemes, as proposed below, I would entrust the case to him."

Paragraph 9.—"The supply of irrigation to tract A-9 is a separate case, and an urgent one. I have frequently urged that the prevention of famine and relief of distress should take precedence of the increase of prosperity."

51. Review of the Local Government.—His Honour the Lieutenant-Governor, in a note dated 8th January 1906, considered that as progress on the Triple Canal Project was likely to be interfered with by immediately pushing on with other projects, it was undesirable then to hustle the case of the utilization of the Sutlej Valley waters, especially in view of shortage of establishment.

The question was not, however, dropped. As will be seen the preparation of projects in connection with areas coming within the limits of irrigation of the Sutlej Dam Project never ceased.

52. Irrigation of the Rangoi Tract.—In 1905 Mr. Kennedy made a proposal to carry water from the Sirhind Canal past Patiala and across the Ghaggar and Sarusti Nalas to irrigate the A-3, A-14, A-15 and A-16 tracts. Surveys for the project were made during 1905—07.

A complete project was prepared and submitted to the Government of India under No. 260-I., of 17th January 1908.

The Government of India, in No. 297-I., of 18th March 1909, stated that this project should be abandoned as it was doubtful if tracts A-13 and A-14 would be benefited by canal irrigation, and that tracts A-15 and A-16 would best be provided with irrigation from the Western Jumna Canal under the Sarada-Ganges extension which had just been proposed (see paragraph 37 *ante*).

53. The A-9 Rori-Chautala Tract.—Different alignments were tried and the final estimate prepared was ready in 1915 and closely conformed to Mr. Kennedy's proposal (mentioned in paragraph 48 *ante*) for a branch taking

out from the Bhatinda Branch near Phul Distributary Head. However, at that time the Sutlej Dam Project was beginning to assume its present shape and the estimate was never submitted as the irrigation of tract A-9 formed an integral part of the new scheme.

54. Extension of irrigation south-west of the Sutlej Navigation Channel in Ferozepore and Faridkot.—In 1881 it was proposed to extend irrigation into this tract, but the proposal was not carried into effect by 1892 when the completion report of the Sirhind Canal was submitted, but it was recorded therein as being a desirable extension. When the Sutlej Valley Project was first proposed in 1903, this area came within the limits of irrigation of the canal from Harike. When the site of the upper weir was finally fixed at Gandasinghwa, it was seen that this area could only be irrigated from the Sirhind Canal.

In 1917 the Chief Engineer decided that the irrigation of this tract should not be delayed pending the execution of the Sutlej Dam Project but that the construction of distributaries for kharif irrigation only should be put in hand forthwith by the Ferozepore Division as a charge to the open capital account of the Sirhind Canal.

The supply of water and the capacity of the channels required to carry it to distributary heads are available owing to the fact the Sutlej Navigation Channel has been abandoned for navigation and is only utilized as an escape.

55. Irrigation in Maler Kotla.—When the Sirhind Canal was constructed, the State of Maler Kotla, which lies mostly between the Bhatinda and Kotla Branches, did not desire irrigation from the canal. In 1912 the Nawab made a request for irrigation which could not be complied with in full owing to the fact that the heavy drainages passing through the State made it undesirable on account of the liability to water-logging which would follow on distributaries being taken across them.

Two small distributaries are, however, now under construction to irrigate the strip between the Bhatinda Branch and the first main drainage.

56. First proposal for a storage reservoir on the Sutlej.—The proposal to construct a storage reservoir on the Sutlej originated in a note by Sir Louis Dane dated 8th November 1908 after a tour from Simla down the Sutlej from Sunni to Bilaspur and over the hills to Nalagarh and Rupar. He indicated the Sunni and Badu Gorges as being favourable sites for dams for storage purposes and power development, also the Sir and Gambar Khads which join the river below Bilaspur, and requested that the Chief Engineer, Irrigation, would have levels taken to investigate the feasibility of any such proposal.

Acting on instructions, Mr. Hindley, then Sub-Divisional Officer, Headquarters, Rupar, went up to Jagat Khana and through the Badu Gorge, returning over the hills *via* Kiratpur, and, in a note dated 26th March 1909, recorded the results of his tour. Later he visited the Neila site and submitted a further report.

57. Proposals for a storage reservoir on the tributaries of the Sutlej.—Rai Bahadur Baij Nath, Executive Engineer, Ludhiana, on 11th June 1909, submitted a report with the sections that had been taken of the River Sutlej above the Badu Gorge and the four tributary khads of the river between that point and Bilaspur, with preliminary figures of capacities obtained with dams of different heights at the various sites. He also submitted a separate report, dated 11th June 1909 on the possibility of a reservoir on the Ali Khad above Bilaspur. Unfortunately he had not seen the khad himself, and the site proposed by him was in a strike valley.

Another site for a dam can be found on the Ali Khad below Deuli village in the gorge, which is only 40 feet wide at the bottom, where the whole run-off of the catchment could be stored, giving a supply of 250 or 300 cusecs for six months. The writer has seen the gorge himself, and considers that it would be a most valuable site at some future date for a supplementary reser-

voir. To develop it at present, would be difficult owing to the lack of communications by which lime or cement could be brought to site. Little or no expenditure on spillways or sluices would be required as the reservoir would hold up practically the whole run-off of the catchment.

58. Neila Dam Project. - Mr. Gordon, Chief Engineer, after visiting the Neila site, in a note dated 29th November 1909, recorded his opinion that Neila was most promising, and gave a statement of investigations that were to be made in connection with it. Rai Bahadur Baij Nath, in his note dated 16th March 1910, recorded all the information called for by the Chief Engineer who subsequently ordered the collection of further information.

Meanwhile, a note was received from Mr. (now Sir John) Benton, Inspector-General, dated 11th April 1910, on the question of a storage reservoir on the Sutlej, in which he recommended that a preliminary report, design and estimate for a dam at Neila might be prepared and submitted to the Government of India as soon as possible. Mr. Blaker, Assistant Engineer, was put on special duty in the Secretariat, and in September submitted his design and estimate, which amounted to Rs. 3,72,29,100, but he shewed that, to be remunerative, an expenditure of only Rs. 1,72,00,000 was justified.

Mr. Gordon, in a note dated 27th March 1911, dealing with this estimate, reported : " There is not, in my opinion, any present prospect of constructing a dam at the site at a cost which would not be prohibitive compared with the benefit to be derived from it; and I do not recommend any further expenditure on investigating the possibilities of the site ".

This note with the design, was forwarded to the Government of India and Sir John Benton, in his note dated 5th June 1911, agreed with the Chief Engineer that further investigation should not be carried out at present.

59. Origin of the present project.—The proposal for a dam was again revived by the Chief Engineer, Mr. Gwyther, in a note dated 20th February 1915, after a visit to Rupar, where the case was put up to him by the writer, who was the local officer. A copy of his note is given as Appendix A-1 to this report; paragraphs 3, 4 and 7 are of importance.

On that note proposals for a Project Division were submitted and approved, and the Division was opened in October 1915, with the writer in charge.

H. W. NICHOLSON, B.Sc., A.M.I.C.E.,

Executive Engineer,

Project Division, Sirhind Canal.

PART IV.

REPORT ON THE EFFECT OF THE SUTLEJ DAM PROJECT ON FAMINE IN THE PUNJAB AND THE NATIVE STATES ADJACENT THERETO BY MR. H. W. NICHOLSON, EXECUTIVE ENGINEER.

1. Result claimed.

It is claimed for the Sutlej Dam Project that, when it is completed, it will remove the word Famine from the vocabulary of words used in official correspondence in the Province.

No attempt is made to describe at length the devastation caused by past famines in the Province and the probability of its recurrence.

2. Records referred to.

The reports of the Famine Commissions and the Provincial and District Famine Reports exist and give all the information available. The bulk of the literature is, however, so great that anyone having to deal with the project and consider its merits as a measure of famine relief would be precluded by want of time from perusing the lengthy reports.

Extracts have therefore been made and are attached as appendices, in preference to writing a description which would carry less weight than the original words of the writers, who were fully conversant with the facts at the time they wrote.

Extracts taken from the following reports are given as appendices as follows :—

- Indian Famine Commission, 1880, 2 volumes (App B-1).
- Famine in the Punjab, 1896-97, 1 volume (App. B-2 and B-3).
- Indian Famine Commission, 1898, 7 volumes (App. B-4 and B-5).
- The Punjab Famine, 1899-1900, 7 volumes (App. B-6, B-7 and B-9).
- Indian Famine Commission, 1901, 1 volume (App. B-8).

3. Maps.

Small scale maps of the Province on a scale of 1" to 80 miles are attached to this report (at the end of appendix G).

Map I, taken from the Punjab Famine Report of 1896-97, shews tracts affected by famine and scarcity in those years.

Maps II, III, IV and V, taken from the report on the famine in the Punjab, 1896-97, shew the crop failures in the four crops, Kharif 1895, Rabi and Kharif 1896, and Rabi 1897.

Map VI, taken from the Punjab Famine Report of 1899-1900, shews tracts affected by famine and scarcity in those years. From this map it will be seen that the Sutlej Dam Project covers practically the whole area affected by famine.

The areas subject to scarcity in Gujrat and Shahpur have since come under the command of the Upper and Lower Jhelum Canals, respectively, and that near Lahore has come under the command of the Upper Chenab. The tract west of the Jhelum consists chiefly of the Salt Range, which it is not possible to irrigate.

4. Change in Government Policy.

The Indian Famine Commission of 1878 records the fact "Government held that the task of saving life irrespective of the cost is one which it is beyond their power to undertake". Since then owing to a development of moral science and economic views there has been a great change, and now endeavours are made to prevent the death even of cattle by subsidising the railways to transport fodder at half the usual rates.

5. Mr. Fanshawe's Views.

Mr. Fanshawe, as Commissioner of the Delhi Province during the famine of 1900, submitted a memorandum to the Irrigation Commission which, from the position he held and his actual experience of the famine, is entitled to due consideration.

The following extract would carry more weight than any views the present writer could express :—

“ When the famine, with its dreadful realities is with us, we all feel that we would allow nothing to stand in our way in effecting anything reasonably practical in the above direction ; but as soon as famine is over and its cost is once booked, financial consideration and departmental ideas reassert their stern sway.

But I venture to think that this is a narrow and wrong view, and that we are bound to provide against famine in every possible way, even at the cost of reducing past revenue and of making remunerative projects less remunerative than they have been in the past. The unsettling which is caused by famine to the villagers, even if actual demoralization is avoided, the losses from death and sickness, the ruinous destruction of cattle, the abnormal strain which famine imposes on all officers, in not a few cases to the permanent detriment of health and energies, if not to actual loss by early retirement or death, are grounds which clearly ought not merely to outweigh mere financial consideration, but which justify fresh expenditure, not directly productive no doubt, but productive fiftyfold in what it saves financially, administratively and morally in keeping off famine. It is extremely difficult no doubt for officers to fully realize that protection against famine, like other things which occur periodically only (this was once the case with our land revenue record and settlement), is an essential part of our scheme of administration, and must be steadily borne in view as such ; and, so far, it has nearly always been the case that our after-famine good resolutions in the above direction have come to very little, or even nothing. But our late experiences, and I fear a possible further, though I trust very limited, experience, warn us that this must no longer be the case, and that we must take stock *de novo* of the whole position, and must be prepared even to give up present income to a limited extent if thereby we can provide against famine or reduce the area of its operation ”.

6. Finance versus Statesmanship.

The Sutlej Dam Project is the boldest storage irrigation scheme that has been elaborated in the world, and its inspiration has been “Hissar,” and “Famine”—practically two synonymous words. The capital to be sunk per acre irrigated is necessarily high in the case of irrigation made possible by water stored in a reservoir 200 miles away from the field where the crop will be matured. The cost per acre, however, although high relative to that incurred in the case of the easier projects which have been constructed, compares very favourably with the cost of irrigation performed by sinking a well and drawing the water by bullocks. Well irrigation, however, is not possible in the tract in question ; therefore the value of canal irrigation would be higher considered from the point of view of supply and demand.

The custom, however, has continued of charging only nominal rates for canal-irrigated crops, and it is a question whether the project will be a remunerative one or not when finally considered by the Finance Department, in view of the effect of the war on the future rate of interest charges. It will then be a case of statesmanship whether views will be taken which will override the result of elaborate calculations based on erroneous premises.

7. Death of Cattle.

Attached (as appendix B-9) is a statement compiled from Volume VI of the Punjab Famine Report of 1900, which shews by districts the net loss of cattle in the Delhi Division in the famine of 1899-1900.

The total loss of cattle in the division was 1,223,000, of which 418,000 were in the Hissar District alone.

These figures were obtained by actual census in February 1899 and the end of 1900. Taking an average value of Rs. 25 per head, the total loss would be Rs. 305 lakhs, of which Rs. 112 lakhs would be in the Hissar District only.

These figures are not given with the idea of enabling elaborate calculations to be entered into, but only to indicate the magnitude of the sum at stake on the credit side of the account—one of the many that cannot be given credit for under the departmental rules at present in force.

8. Cost of Famine Relief in the Past.

No endeavour has been made to aggregate the total actual cost of famines in the past in the tract lest the mind be distracted from the moral and general economic aspect of the case, which cannot be gauged by the amount registered as direct expenditure on famine relief.

An item of expenditure which is incurred by Government continually, and not in so-called famine years only, is that incurred in paying the railway the difference between the normal and the concession rate for the transportation of fodder into districts in which the supply is insufficient owing to short rainfall. The official figures have not been available, but in the "Pioneer," a couple of years ago, it was stated that in the year Rs. 18 lakhs of expenditure had been incurred on this account in that year.

The Sutlej Dam Project, on completion, would relieve Government of the liability to a great part of such expenditure; for this again no credit can be taken in the project accounts, although, it is a perfectly evident asset.

9. Interval between Famines.

The Irrigation Commission, 1901—03, in their general report, paragraph 15, point out that the south-east Punjab in a fifty-year period is subject to 13 "Dry Years," which include 5 years of "Severe Drought".

This tract ties with the Madras Deccan for the first place in the list for the greatest liability to experience "Dry Years".

Mr. Wilson pointed out to the Commission that the importance of artificial irrigation varied inversely with the amount and certainty of the local rainfall. On that basis of argument, Hissar District would be one in which the heaviest expenditure on irrigation would be justified of any district in India.

10. Maximum Capital Cost justified per Acre irrigated:

Later, in paragraph 107 of the report, the permissible capital expenditure in providing irrigation is symbolized in the equation —

$$C = 20r - mx.$$

In the case of Sholapur in the Madras Deccan, the Commission then evaluates the equation, and shews that expenditure justified in that case would be Rs. 221 per acre, the net revenue per acre "r" in the above equation being taken as Rs. 2-8-0.

It is certain that the cost of an acre of irrigation under the Sutlej Dam Project will not be more than a fraction of that figure.

11. Hissar—the Worst Famine District in the Punjab.

The Irrigation Commission, in paragraph 2 of Chapter XIV of their report, give index numbers to each district to indicate their insecurity, and it is found, that the two worst districts are Hissar 16 and Rohtak 26. The index numbers represent the percentage of crop matured in the famine year of 1900 on the normal area matured. The greater part of this area matured in 1900 was by irrigation from the Western Jumna Canal, which irrigates a small portion of both districts.

Mr. Field, Chief Engineer, in his note dated 25th October 1902 for the Commission, dealt with the case of famine and the value of irrigation in the tract:—

"The condition of Hissar and Sirsa, and portions of Rohtak and Karnal, has long been a cause of great anxiety. The continual failure of the rains and the short supply in the Western Jumna Canal have resulted in a chronic state of famine and distress. The Provincial Government has for some time been exercised as to means by which this state of things can be remedied, . . ."

the prosperity of the famine-stricken areas would be assured, or at any rate the worst evils of famine be averted. Such a scheme would require very careful examination, and there is no doubt whatever that the cost would be extremely heavy. But even so, the protection of the tracts above mentioned from recurring famines would be worth almost any sum that the scheme is likely to cost. . . . ”

12. Difficulty in getting Reliable Data on which to estimate.

To attempt to calculate the protective value of the irrigation to be introduced into the tract would be useless, as the only figures available would be those compiled by the Settlement Officer. How misleading any results obtained from them would be may be judged from the fact that the land revenue in the Hissar District in the tract irrigated by the Sirsa Branch of the Western Jumna Canal is $6\frac{1}{2}$ annas per acre for rain-cultivated land, and $8\frac{1}{2}$ annas per acre for canal-irrigated land, or a difference of two annas per acre.

The above figures are given by the Deputy Commissioner, Hissar, in his No. 3663, dated 5th October 1918.

The land revenue purports to be “ half-nett assets,” from which the deduction would be that the benefit to the land-holder is 4 annas per acre, which would mean that a land-owner who was fortunate enough to get 200 acres of his land irrigated would just be able to pay an annual subscription to the “ Pioneer ” from the benefits received !

That settlement figures are of no meaning other than for the purpose of settlement, and that no arguments can be based on them, has been ably demonstrated by Mr. W. S. Hamilton, I.O.S., late Director of Agriculture and Industries, in his pamphlet officially published entitled “ Expenses and Profits of Cultivators in the Punjab, 1916 ”.

It will therefore be seen why no attempt has been made to collect figures to show what the actual losses due to famine are, or the benefits from irrigation which would be likely to accrue.

13. Tour through the Tract.

The country is so inhospitable and vast that to tour through it in the ordinary way takes a long time. To get a good general opinion of the country after the surveys were completed, and it was known that it was all commanded, the writer made a tour through the tract without tents in March 1918. In four and-a-half days a circular tour was made, 250 miles being covered on camels ; one's necessities of life were carried on riding camels, which kept company the whole time, so that there should be no danger of losing the necessities, if not the comforts, of life in this inhospitable tract.

Two nights were spent in the open, which was no discomfort at that time of the year, compared with the fact that the ration of water had been cut down to three bottles of soda a day.

14. Water for Drinking Purposes.

The drinking water available in the few village tanks there are, six months after the end of the rains, can only be described as being sullage. The wells are bitter in the greater part of the tract, so that, so long as there is any “ liquid ” in the village tank, even if there is a village well, it is drunk in preference to the well water ; the wells, through being out of use, are nearly as foul as the tanks ; moreover, both are liable to fail in times of drought.

Heavy expenditure is incurred, without anyone being surprised, in procuring a wholesome supply of drinking water in large towns.

In the case of an irrigation project like this, one of the greatest benefits conferred is the introduction into the tract of a good supply of drinking water for man and beast. No one will deny that this supply of drinking water is an advantage not only from a point of view of comfort, but from its economic service in improving the health of the inhabitants and cattle in the tract, which cannot be estimated. To attempt to evaluate this benefit in rupees is impossible ; at the same time, it would be impracticable to endeavour to realize income from this use of the water ; still it is a great asset to the community that cannot be lost sight of.

15. Native States.

The benefits of the project as a famine preventive measure have been considered so far mainly with reference to British Territory, and particularly in connection with the Hissar District.

This district is nearly surrounded by Native States so whatever references have been made to British territory apply equally to the States.

The area brought under command by the project in the tracts subject to famine is about 3,600,000 acres, in all of which some 1,400,000 acres are in Native States.

The area to be irrigated will be not less than 40 per cent. of the commanded area. The fact that the Native States concerned—Bikaner, Patiala and Jind—have rendered such loyal service in the war, and that the Sutlej Dam Project will remove the dire effect of famine from the large areas concerned, will appeal to the mind of an imperialist.

H. W. NICHOLSON, B.Sc., A.M.I.C.E.,
Executive Engineer, Project Division, Sirhind Canal.

APPENDIX A-1.

Note, dated 20th February 1915, by F. E. Gwyther, Esq., C.I.E., Chief Engineer,
Irrigation Works, Punjab, on the Dam and Reservoir on the Sutlej
River at Neila Gorge.

I HAVE now seen for the first time the original rough project for a Dam and Reservoir on the Sutlej River at Neila Gorge, and have been impressed by the very poor financial prospects it was made to exhibit. The report argued that the benefits likely to accrue from it could not be valued at a higher capital charge than some 190 lakhs of rupees, a sum obviously inadequate for the provision of a high masonry Dam and its dependent works.

2. It was on these figures that the then Chief Engineer (Mr. Gordon) reported unfavourably on the project; no other conclusion could have been arrived at on the bases of the data adapted—and it was dropped as an impracticable though desirable scheme. But the result is at first sight somewhat startling—it discredits the popular assumption that water is worth its weight in silver in the arid tracts of the Punjab, for a proposal to impound a perennial supply of 1,600 cusecs for the benefit of such a tract is argued to be a financially impracticable proposition.

3. A closer examination of Mr. Blaker's figures has led me to the conclusion that the revenue earning possibilities of the project have been greatly under-estimated, and are needlessly pessimistic. His data were borrowed from existing statistics of the Sirhind Canal, and the following material considerations were not accorded their due weight :—

- (a) the physical conditions of the Sirhind tract are widely different from those obtaining in the areas it is proposed to extend irrigation to; in the former, irrigation is not a necessity, but forms a valuable protection and insurance against drought; in the latter, on the contrary, it is a necessity;
- (b) for that reason the Sirhind Canal cannot be regarded as a wholly efficient machine; its results cannot therefore be fairly applied to tracts differing materially from it;
- (c) the tract to be benefited by the storage project approximates more closely to the Colony Doaba because it is arid, desert and lacking in an agricultural supply of water—especially towards the Bikaner border; and
- (d) the fact that this deficiency of water can only be remedied by extraordinary and costly works in itself forms a sufficient reason for the imposition of higher water and land rates than the Sirhind tract could stand. The latter are as it is by no means high while the needs of an arid tract (if real) would obviously point to the same condition if expensive works are essential for such areas (as they are obviously in this case) their initial cost must be recouped to the State by the imposition of a larger revenue.

4. Looked at from this point of view, the revenue returns adopted by Mr. Blaker are disappointing and, I think inaccurate; i.e., they would be suitable to the areas already irrigated, but are inappropriate to the new lands we wish to water.

He is unable to adopt higher nett rates for kharif than 2.28 per annum irrigated annually, rabi than 2.75 per annum irrigated annually, and takes no credit for indirect revenue (e.g., a share of the land revenue).

Similarly his duties are based on averages I am unable to check; for the years he takes, our volume of statistics yield the following results :—

Kharif	...	86	} 258
Rabi	...	167	

and these are more favourable than the 80—150 he was led to adopt.

5. Under the plea that these new areas are appreciably different as to physical characteristics to the greater part of the Sirhind tract, I am prepared to approximate their revenue earning possibilities to the Lower Chenab Canal where :—

- (i) the duties attained are by no means abnormal—they are lower than those secured on the older Upper Bari Doab Canal; and
- (ii) the water rates are similar, while the addition of indirect credits for land revenue are made to represent something like the true value of the water to the land, which is practically valueless without it.

As regards duties, the Lower Chenab Canal averages for—

Kharif, 78 acres per cusec; and

Rabi, 200 acres per cusec,

the latter being the principal crop.

APPENDIX A-I.

As regards revenue rates, the last year I can quote is 1912-13, when the average direct and indirect rate worked out to $\frac{14,672,803}{2,222,000} = 6.6$ per acre. But the full effects of the new settlements had not then been felt, and it is probable the ultimate average will reach Rs. 7.

6. Accepting these figures, and assuming a Maintenance charge of 1.5 per annum (compared with 1.1 on the Lower Chenab Canal), their application to the Neila Project yield the following results :—

1. Available supply at head of canal branch	...	1,600 cusecs.
2. Area that would be annually irrigated by it $\frac{1,600 \times 275}{1}$	...	440,000 acres.
3. Annual net revenue that could be secured $\frac{440,000 \times 5.5}{1}$	...	24.2 lakhs.
4. Capital outlay equivalent to a return at 5 per cent. on that amount	...	484 lakhs.

That is, under favourable revenue conditions, the project would be by no means a financially unsound proposition : on the contrary by the adoption of full water (or water plus land) rates, we could conceivably justify a capital charge of nearly 500 lakhs of rupees—of which 400 lakhs could be spent on the impounding dam and its reservoirs ; the balance on remodelling existing, and making new, channels.

7. The result may be regarded as an unduly optimistic forecast ; it might legitimately be viewed as much a possible maximum, as Mr. Blaker's figures are, in my opinion, an absolute minimum. But their adoption is desirable for two reasons :—

- (i) they will indicate to Government the extent to which abnormal (from our point of view) works of this type require to be financed in order to make them feasible—and how they compare in that respect with the more normal works for irrigation which abound in the Punjab ; and
- (ii) they afford a sufficient excuse for proceeding with and elaborating a storage project on the safest possible lines—assuming that the selected site is a really suitable one for a high dam.

My own conviction is that the forecast I have attempted is by no means an impossible one, and that it brings the project within the scope of works that are practicable ; that it is desirable, no one can deny. As experts, it is our duty to elaborate such a scheme, and to place it before Government and to explain—

“ Here is a proposal which we think should not cost more than “ x ” lakhs, and which would prove of enormous benefit to certain famine-swept arid tracts ; we recommend it as the only practicable solution of the problem of protecting this area, and we know it is possible to make it financially a sound scheme by charging fully for the water-supply thus secured, as is being done on our newer canals. ”

It will then lie with the revenue authorities to accept that forecast—or something approaching it—or to rule that water rates of that magnitude are, if not impracticable, at least unjustifiable.

8. It is obvious that any impounded supply should be used solely in extending irrigation to :—

A.—The Dalwali tract of the Hissar District (on the right bank of the Ghaggar River) Mr. Kennedy's tract A-9—where 500,000 acres are lying waste, and where provision could fairly be made for annually irrigating at least 300,000 acres ; and

B.—Bikaner lands beyond, that may be irrigable.

None of it should be reserved for the low khadir lands at the tail of the Sirhind Canal (where water is not really wanted and subsoil saturation is increasing as a result of the working of the Grey Canals), or for extension of irrigation beyond present limits of percentage in the old tract.

9. In taking up and elaborating this project, care will have to be taken to examine more closely the physical features of the selected site, and to consider with care the maximum volumes that dam may be called on to pass. I am unable to trace what investigations were made in former years by Rai Sahib Tej Ram and others—but whatever was done should be clearly recorded in a brief but precise note, so that we may be clear as to what further enquiries will be needed later to establish the suitability of the site. I gather that site No. 2 was considered better than No. 1.

Meanwhile, the data for river flood discharges, and for a suitable dam design based on data previously collected, might be collected. As to the latter, I do not favour the multiple arch type for so high and important a structure : it seems to me the gravity type,

APPENDIX A-I.

straight or arched in plan should be worked up at least in alternative, and that the possibility of making it largely of good *kankar* lime concrete should be seriously considered, as is being done on similar works elsewhere in India. *Kankar* of the Patharheri type gave such fine results when available that it would be worth while investigating for further fields of it, and considering its use here. The use of cement at present high Indian prices leads to heavy expenditure.

The project should not lose sight, as the previous one did, of the need for tunnels to dispose of the river supplies during construction, and of the treatment of timber (drift or otherwise) in a suitable manner. I believe most high American dams are compelled by law to make provision for the passage of the latter, and enquiries should be made as to the methods usually adopted for the purpose.

10. In a recent note submitted with his No. 172-C., dated 26th January 1915, the Superintending Engineer has remarked on the effect the lining of the main line will have on this project. Briefly, the case as regards lining stands thus: the diminution of water losses in the soil will not for the purposes of this project increase the available supply—any advantage gained thereby will be absorbed by existing areas as it is comparatively insignificant; but the complete or partial lining of the main line will result in economy to the storage project because it will enable us to pass the additional 1,600 cusecs discharge with a minimum of remodelling. If the lining has to be abandoned for any reason, the cost of remodelling the main line for this project will be heavier.

That is financially the only connection between the two, and all we need concern ourselves about at present.

APPENDIX A-2.

Closed Drainage Tract.

HIS HONOUR asked me on the 10th February 1919 to look into the "Closed Drainage Tract" case, and to let him know how this case stood. There is very voluminous correspondence about this tract, which is the area affected by the Umla, Tangri, Markandah, Sarusti, Chautang and other smaller drainages. The accompanying 1"=4 miles plan of the Bhakra Dam Project shows all these drainages crossing the proposed Patiala-Kaithal Feeder.

2. A project was got out under Mr. Gwyther's instructions for a great catchwater drain to divert the waters of the lesser drainages into the Markandah, and to bank the last named channel. This was, however, not proceeded with in view of the Bhakra Dam Project having been in the meantime taken up, which would provide properly controlled flow irrigation for this tract on the right of the proposed Patiala-Kaithal Feeder. In addition to this, what is also needed is to begin opening up these drainages and their outfalls from their downstream ends and to work upwards; and, in preparing the details of the Bhakra Project, this has been found to be practicable, and the Bhakra Scheme will provide flow irrigation to this tract (on the right of the Patiala-Kaithal Feeder), which is at present either swamped out or lies arid, while the drainages will be led off down properly aligned and graded channels, and be thus prevented from spilling over the country and causing the mischief which they have been doing in the past. In connection with this, the worst of the tracts so affected, *viz.*, the Nili Assessment Circle, is being taken up now, and an estimate is under preparation, independent of the Bhakra Project, to straighten out and shorten the Sarusti Nala from Pehowa, down to its junction with the Ghaggar (see Survey of India 1"=1 mile sheet attached, which shows in red lines the proposed short cuts). By this means we get an extremely good slope and outfall, and the present evil of swamping in this tract will be overcome, the country dried and the health of the people improved, while irrigation under the existing conditions by means of the Polar Regulator and Para Bund will be brought under proper control till the Bhakra Scheme is sanctioned. Later, when the Bhakra Project materialises, flow irrigation from it will displace the present primitive methods of irrigation, the Polar Regulator will vanish, the Para Bund will be gapped and irrigation extended, while the whole supply of the Sarusti from Pehowa downwards will be led away down the proposed straightened and shortened channel of the Sarusti into the Ghaggar, and the improved channel will become a natural drainage of the country; and, being deep and having an excellent bed slope and outfall, will keep within its section, and spills from it will cease. The application of the above principle is, I think, the only solution to be applied in the "Closed Drainage Tract"; *viz.*, in short, to provide firstly, proper drainage methods to prevent spills swilling the country, and simultaneously to provide well-controlled flow irrigation over the tract so dried from inundation; and this principle will be acted up to in all the areas affected.

Due provision is being made in the Bhakra Project to pass each of these drainages unobstructed across the proposed Patiala-Kaithal Feeder. Further on, each will be dealt with according to the conditions prevailing on it, and the same principle applied as is being applied to the Sarusti case, explained above.

H. W. M. IVES,

Chief Engineer.

4-3-19.

MANY thanks for the above note, which states the position very clearly, and shows that the matter is receiving all the consideration possible at this stage.

M. O'DWYER.

6-3-19.

APPENDIX B-1.

Extracts from the Report of the Indian Famine Commission for the years 1878-80, Part I.

Paragraph 5.—... and the Government desired that the whole subject should be exhaustively treated, special notice being taken of any defects of administration that may have contributed to retard the extension of irrigation in the less successful works of this nature.

Paragraph 22.—In the southern districts between the Sutlej and the Jumna there is barely sufficient rain for agricultural purposes, and here the failure of the monsoon has frequently involved the country in droughts.

Paragraph 39.—The tract which is most subject to drought includes (1) the western and southern parts of the North-Western Provinces and that portion of the Punjab territory which lies east of the Sutlej; (2) the western and northern States of Rajputana and of the central plateau which border on the North-Western Provinces.

Paragraph 61.—In January 1877, Sir R. Temple (selected on account of experience in Behar in 1874) was sent as famine delegate of the Government of India to inspect the distressed districts, and to communicate personally with the two Governments concerning the measures to be taken for the relief of distress. The instructions given him are of importance as shewing the opinions of the Government regarding the nature of their responsibility for the relief of famine. The principle was reaffirmed that the Government would spare no efforts "to save the population of the distressed districts from starvation, or from an extremity of suffering dangerous to life", but they would not "attempt the task of preventing all suffering and of giving general relief to the poorer classes of the community". "Everyone", it was said, "admits the evils of indiscriminate private charity, but the indiscriminate charity of a Government is far worse". The Government held that "the task of saving life, irrespective of the cost, is one which it is beyond their power to undertake", but believed that "from the history of past famines, rules of action may be learnt which will enable them in the future to provide efficient assistance for the suffering people without incurring disastrous expenditure". The Secretary of State approved these instructions.

Paragraph 68.—The parts which suffered most from the drought were those districts of the Delhi and Hissar Divisions not protected by the Western Jumna Canal, which are always among the first affected, and the hill district of Hazara, which had not been known to suffer in any earlier famine. The distress was, however, nowhere intense; the ordinary measures were taken to supply relief, and with the rains of 1878 all fear of famine passed away. The mortality returns, however, which indicate an excess mortality of about 340,000 above the average during the year 1878, afford reason for fearing that the high prices had a grievous effect on the poorer classes of the population.

Paragraph 79.—During the first quarter of the present century the position of the British in the country was not such as either to create any sense of a general obligation to give relief, or to supply the means of affording it. During the next 30 or 40 years, as the country became settled and all branches of the administration improved, the sense of this obligation was developed, and more and more fully acted on; but there can be little doubt that on many occasions the wants of the people were very incompletely met, and that much suffering and mortality must have ensued. Allowing for the cases in which no records exist, it may be estimated that for the first 70 years of this century about 8 millions sterling were spent in direct State relief, and a somewhat larger amount was contributed as a remission of land revenue for a total population rising from 100 to 200 millions. The far larger sums which have been spent more recently on similar objects, amounting during the six years 1873-79, to not less than 14½ millions in direct outlay and 2½ millions in loss of revenue, are still small when compared with the cost of the relief of the poor of England, which for a population of 34 millions amounts to about 7 or 8 millions in a single year.

Paragraph 88.—The Native Governments whom the first British administrators represented, and to whom they ultimately succeeded, scarcely attempted anything beyond occasional and unsystematic acts of alms giving, and the earlier despatches of the Bengal Government, while breathing a tone of sincere compassion for the sufferings occasioned by famine, are busied rather with its fiscal results, as affecting the responsibility of the Company towards its shareholders, than with schemes which would have seemed wholly visionary, for counteracting the inevitable loss of life.

Paragraph 93.—The painful lesson taught by this calamity sank deep into the minds alike of the rulers of the country and of the English public, and its results were apparent in the administration of the famine which three years afterwards visited the North-Western Provinces, and still more in that which in 1873-74 was experienced in Behar. In 1868 every district officer in the North-Western Provinces was reminded that "he would

APPENDIX B-1.

be held personally responsible that no death occurred from starvation which could have been avoided by any exertion or arrangement on his part or on the part of his subordinates", and an outlay on a very large scale was incurred in the measures adopted by the Government for the employment and relief of the population.

Paragraph 94.—Prudential considerations were subordinated to the paramount necessity of relieving distress and obviating mortality; life was preserved, but money was spent profusely, and a famine of unusual brevity and of no exceptional severity was found to have involved an expenditure of about 6½ millions, or as much as had been spent in every form of relief, in the previous famines since the commencement of the century.

Paragraph 96.—With the experience of 1873-74 fresh in their memories, the Government conveyed to their officers engaged in conducting the measures of relief a warning as to the extreme importance of guarding against wasteful expenditure. The prudence of such a caution was shown by the fact that, in consequence of the long duration of the famine, and the extensive area over which it spread, the direct outlay on relief eventually reached the sum of nearly 8 millions, thus raising the whole amount spent in five years between 1873 and 1878 to no less than 17 millions sterling, besides about 1½ millions lent to Native States to assist them in carrying out measures of relief.

Paragraph 103.—A main cause of the disastrous consequences of India famines, and one of the greatest difficulties in the way of providing relief in an effectual shape, is to be found in the fact that the great mass of the population directly depends on agriculture, and that there is no other industry from which any considerable part of the community derives its support. The failure of the usual rain thus deprives the labouring class, as a whole, not only of the ordinary supplies of food obtainable at prices within their reach, but also of the sole employment by which they can earn the means of procuring it.

Paragraph 178.—There is, however, one direction in which the responsibility and power of usefulness of the local Governments could be enlarged in respect to famine relief. The surplus created for famine purposes may, under existing arrangements, be applied to the prosecution of public works likely to mitigate the consequences of famine whenever the income of those works can be reasonably expected to cover the interest on their cost, and thus to secure the Government from charge on their account. In extension of this policy, we think that all reasonable facilities should be given to the local Governments to undertake works likely to protect their provinces against the results of famine, even if not of a character to be immediately remunerative, in every case in which they can secure the Government of India against eventual loss by the specific allocation of some part of their provincial revenues. Nor does it appear to us in any way objectionable in principle to levy special local rates or cesses, either on a whole province or some smaller area, in order to provide a fund from which such guarantee may be obtained.

Paragraph 190.—There are two main kinds of migration to be dealt with. One is migration for the sake of cattle—to find pasture; the other for the sake of the emigrant's own safety—to find food or employment; and there is a third, or spurious, kind, *viz.*, aimless wandering. Of the first kind of migration we have examples in the famine of 1868, when herds of cattle were driven from Western Rajputana to Malwa, Central India, and the Sub-Himalayan pastures; and in 1876-77, when the cattle of the Deccan, Mysore and Madras were driven to the forests on the Western Ghats. Such migration is purely beneficial to those who start early enough on the quest; and, though it often entails great losses on those who start late and arrive when all the best pastures have been occupied, the loss would probably have been as great had they remained at home. All that Government can do here is to aim at some control over the distribution of the incoming cattle, to open one tract after another as the first becomes filled and to disseminate information as to the best roads to be taken. It may be useful also to adopt the course taken by the Bombay Government in 1877 to facilitate the transport by rail of cattle travelling towards the pastures, and to place fodder for sale along the most frequented roads, though the latter measure proved to be unnecessary.

Chapter V, Section 11 of Famine Report, Part II.

Paragraph 1.—Among the means that may be adopted for giving India direct protection from famine arising from drought the first place must unquestionably be assigned to works of irrigation. It has been too much the custom in discussions as to the policy of constructing such works, to measure their value by their financial success, considered only with reference to the net return to Government on the capital invested in them. The true value of irrigation works is to be judged very differently. First must be reckoned the direct protection afforded by them in years of drought, by the saving of human life, by the avoidance of loss of revenue remitted and of the outlay incurred in costly measures of relief. But it is not only in years of drought that they are of value. In seasons of average rainfall they are of great service and a great source of wealth, giving certainty to agricultural operations, increasing the outturn per acre of the crops and enabling more valuable descriptions of crops to be grown.

APPENDIX B-1.

Paragraph 2.—The outlay on completed canals in the Punjab up to the close of 1877-78 had been £ 2,260,000. It may without exaggeration be reckoned that one-half of these crops would have perished if unwatered, or would not have been raised at all if the canals had been absent. So that altogether in that one year the wealth of the Punjab was increased by these two canals by £ 1,438,000—an amount equal to about two-thirds of the cost of the works; and, but for the protection they afforded, Government would have lost heavily from the necessity of remitting revenue and providing for famine relief. The nett canal revenue for the year in the Punjab was, however, only £ 119,000—being about 5½ per cent. on the capital outlay on works in operation—a result which obviously supplies a wholly inadequate test of their value to the country.

Paragraph 10.—It would indeed be a great error to test the value of irrigation works on their direct revenue alone. It should be considered rather whether any particular tract is liable to frequent or serious drought, and whether, in the event of famine, the population is such that a large outlay would be necessary for its relief, and a large loss of revenue would be incurred. If these questions are answered in the affirmative, and if at the same time it is possible to introduce irrigation from a source which can be relied on in years of drought without any excessive cost, Government might usually embark on the enterprise without hesitation. The certain result will be an increase of the prosperity, and of the general well-being and productive power of the population and the development of every indirect source from which the wealth of the country springs. Looking at the present position of India in respect to irrigation, it would be hard to find any system of works that is not worth to the country the money that has been spent on it.

Paragraph 11.—But, though these conclusions may, we believe, be confidently accepted, experience has shown that irrigation works may be constructed which are of extreme benefit to the country, and the water of which is eagerly taken for irrigation in time of drought, and yet that the nett income they earn may not for a considerable length of time cover the working expenses together with the interest on the original outlay. The works thus cause a charge on the general revenues of the country, and the question arises whether the construction of similar works can be justified, and, if so, by whom that charge should be borne, whether by the general body of tax-payers throughout all India, or locally by the province in which the works are constructed, or, more locally still, by the owners of the lands through or near which they pass, or which they may benefit.

Paragraph 14.—The arguments that have arisen on this subject have extended over many years, and can hardly be said to be yet concluded. The point which has been most discussed, and which may here be noticed, is whether these charges should be imposed on the province as a whole, or on the special tract which the canal traverses. In behalf of the latter system, it has been contended that, where land-owners who could benefit by the works ignorantly or obstructively refuse to take advantage of them, the charge which arises from the first cost and maintenance of the works should be borne by them, and not by other classes who could not directly derive advantage from the works. The law of Northern India, which recognizes in the provision of such advantages, whether made use of or not, a sufficient justification for the enhancement of the rent of a tenant, supplies a strong argument by analogy in favour of this view. Neither can it be questioned that in a country in the condition of India, in which the Government is compelled to assume the responsibility of acting on behalf of the whole community, there must be a presumption in every case that a public work carried out for the general advantage has obtained the tacit approval of the classes for whose convenience it is designed, and that *prima facie* those classes should be principally responsible for the cost of the advantage.

Paragraph 16.—There can, however, be no doubt that a canal must be a source of security and of protection in all seasons to the districts through which it runs, even if its water is little used in ordinary years, and, if the cost of its construction renders the necessary charges disproportionate to the money value of the water at such times, and that, especially in seasons of drought, it will be of inestimable advantage. Experience shows that on the occurrence of a season of drought water is eagerly demanded, and that a permanent extension of irrigation invariably follows such a season. As we have noticed, the value of the crops rescued by artificial irrigation in a single year may at times exceed the entire capital outlay on the construction of the canal. And it should be remembered how far-reaching are the effects of famine, how all classes are embraced in the calamities that follow in its train, how great a shock it is to the material resources, the credit, the enterprise and the life of a province. It seems to us therefore most reasonable that every province as a whole may be called on to contribute towards the necessary cost of any such works undertaken as an insurance against the occurrence of such a disaster.

Paragraph 23.—There are in this province tracts where the construction of canals appears urgently necessary for famine protection; and others at present lying waste and uncultivated might be rendered cultivable by conveying to them a supply water, which it would not be difficult to draw from the great rivers of the country.

APPENDIX B-1.

Paragraph 24.—Of the first class may be named the tract lying between the Jumna and Sutlej in the Delhi and Hissar Divisions, which at present stands exposed to constant risk of drought, and is, in fact, the locality where in any year of deficient rainfall distress is soonest and most acutely felt. The average yearly rainfall does not exceed 13 inches; and, as only 10 inches fall in the season of summer rain, it is nearly always insufficient for successful farming; while the subsoil water lies more than 100 feet below the surface, a depth so great as to preclude well irrigation, except for small garden plots. Part of this tract will be protected by the Sirhind Canal when it is opened; but a large portion of it lies beyond the scope either of that or the Western Jumna Canal, and no scheme has been framed for supplying it with irrigation at all seasons. For the present we recommend that every effort be made to open the Sirhind Canal, of which the construction seems somewhat unaccountably to have extended over 12 years, and to complete the remodelling of the Western Jumna Canal, which has been under discussion for at least 25 years. When these works are completed, the engineering staff, and the funds now demanded for them, might be applied to the preparation of projects for the irrigation of the waste tracts of the Punjab to which we have referred, and attention should be turned to the irrigation of Sirsa and Hissar.

Paragraph 43.—We are informed that a project of the character above referred to has been under the consideration of the Government, but was set aside as involving too large an outlay. The general question of adding an available food supply for India which should be beyond the reach of any vicissitude of season is, in our opinion, of such extreme importance that we do not hesitate to advise the careful reconsideration of this project, with a view, if possible, of bringing it within practicable limits of magnitude and expense, and of taking a first step in the direction of giving a permanent system of irrigation in which complete confidence can be placed. The benefits thus to be secured to India as a whole would be extremely great.

APPENDIX B-2.

Extracts from Provincial Reports on Famine in the Punjab, 1896-97.

Paragraph 1.—The Punjab.....had enjoyed a series of excellent harvests from 1892 to 1895.....hence it is that though, judged by the number of persons relieved, the expenditure incurred, the extent of crop failures, the duration of the drought and dearth of fodder and the high prices which prevailed, the Punjab famine of 1896-97 was probably as severe as any famine which preceded it since annexation, yet, as compared with other parts of India, the Province must be regarded as having escaped somewhat lightly.

Paragraph 2.—The result is in the main due to the circumstance that cultivation in the Punjab is so largely protected by irrigation.....in all well-irrigated tracts agriculturists look for the assistance of timely showers to supplement the efforts of their well cattle and give the hard-worked animals an occasional respite from labour. In parts of the Province failures of well crops ensue if this assistance is not received. It is, however, a feature of the Province that a very large area is protected by artificial irrigation, and year by year the proportion of cultivation thus rendered secure is increasing. What can be done when irrigating sources are strained to their utmost is illustrated by the crop figures of 1896-97, in which year the area of harvested crops grown by irrigation exceeded the normal by nearly 20 per cent, and amounted to 47 per cent of the total area of crops grown in that year, as compared with a normal proportion of 30 per cent. only.

Paragraph 9.—The following figures taken from statement II-A represent the percentage of deficiency (as compared with the average of ten years) of the harvested area in the nine famine districts during the four seasons just described :—

District.					Kharif, 1895.	Rabi, 1896.	Kharif, 1897.	Rabi, 1897.
Hissar	...	...	...	...	70	54	75	74
Rohtak	...	...	...	...	23	46	18	67
Gurgaon	...	...	...	...	13	24	12	14
Delhi	...	...	...	...	6	24	Nil	40
Karnal	...	...	...	...	26	40	32	41
Ambala	...	...	...	...	6	40	8	47
Ferozepore	...	...	...	...	34	11	33	35
Lahore	...	...	...	...	23	24	16	24
Gujrat	...	...	...	...	23	22	30	21

.....Hissar, Rohtak and Gurgaon are in the Delhi Division, and the kharif harvest in these three districts, which depends almost entirely upon the monsoon rains, is in area on the average about double the rabi. In the remaining districts of the Delhi Division the normal rabi area only just exceeds that of the kharif harvest. The average area under wheat in the whole of the Delhi Division amounts to only 9 per cent of the total area under the crop. It will therefore be understood that this division is more affected by bad kharif harvests than by failure of the spring crops, and this is particularly the case with the Hissar District, in which the kharif harvest in a normal year amounts to 70 per cent of the total crops and pays five-sixths of the revenue of the district. What is implied by crop failures such as are denoted by the percentage figures in the above table is expressed in a concrete form by the Deputy Commissioner of Hissar, who calculates that, while in a normal year his district produces nearly 60 per cent more food than the people require, in the year 1895-96 the crop sufficed for little more than half the population and in 1896-97 for only one-third.

Paragraph 10.—The contraction of the cropped area consequent upon drought is not the only symptom of agricultural distress in seasons of scarcity in this Province. A feature of Punjab famine of almost equal significance with crop failures is the mortality among cattle caused by the drying up of fodder supplies, and thus at a time when the normal food supplying area of the people undergoes serious diminution an extra demand for fodder crops to supplement the insufficient pasturage and keep alive the residuum of cattle necessary to agriculture is made at the expense of grain-producing crops.

Perhaps, however, the most considerable calamity from which the Province occasionally suffers is extensive mortality among the cattle, caused usually by the failure of the kharif rains and crops. in the western half of Karnal, and the Hissar Division, the failure of the autumn rains, though not involving a famine if the rabi sowings are secured, produces terrible mortality among the cattle.

Paragraph 37.—The Rohtak District has always suffered in times of famine in a degree less only than in Hissar, but since the last period of scarcity the unprotected part of the district has been greatly reduced.

Paragraph 40.—The Deputy Commissioner's description of the insecure area in this district.....is a very true one. Partly owing to the character of the inhabitants, and partly to its dependence on rainfall, the harvests in the Nardak and Naili tracts in Karnal are always precarious.....

APPENDIX B-2.

Paragraph 42.—It is curious that the most distressed portions of the district were situated within the area commanded by the district inundation canals. The fact is that, owing to very low water in the Sutlej, these canals generally failed to work in 1896.....
 Ferozepore.

Paragraph 45.—.....The Deputy Commissioner of Hissar, calculating by the hide export statistics, reports that "132,325 animals, or 92 per cent of the plough and well cattle of those found to exist in April 1895, disappeared in the two years following the next October"

Paragraph 47.—.....But it must be remembered, that when drought is universal, there is but little grass, even in closed reserves. Half the stock of the Hissar Cattle Farm were sent away, sold or died; and, notwithstanding the extensive area of this reserve, the remaining 4,216 head were only kept alive at an expenditure which, if the figures given by Captain Dunlop-Smith on page XII of appendix I are correct, nearly approached 4 lakhs of rupees.
 Utilization of forests.

Paragraph 52.—.....At no time has the export trade to the ports ceased entirely. During the year 1896-97 seventy-five thousand tons, or 80 per cent of the total exports, were carried to the seaboard. Of the imports of the same year half came from Sindh, which province largely contributed to the support of the population of the Hissar District during the present famine.

Paragraph 103.—.....It is worthy of note that in the year 1896-97 the irrigation revenue, largely owing to the drought, exceeded that of the previous year by 37½ lakhs. Allowing for increased working expenses, the gain was 35½ lakhs, so that Government has in a year of famine gained in irrigation revenue more than double what has been lost in land revenue. In fact, this gain in irrigation revenue more than covers the cost to Government of the relief operations and the loss of the land revenue. The gain, however, is wholly imperial The loss is largely provincial.....
 I proposals of recovery.

Paragraph 109.—.....Deaths from bowel complaints which, as above noticed, occurred in the Hissar District as a result of an unusual and unwholesome diet, are of course indirectly caused by the famine.
 Deaths from starvation.

Paragraph 111.—.....Previous to annexation, the country suffered from several famines, of which the ever-remembered famine of 1783 A. D. was the most noteworthy.....Of this famine it has been said: "No one who has ever been brought much into contact with the agricultural population can have failed to observe the enduring mark left on the country and its tenures by the famine of 1783 A. D. In Hissar, for instance, that famine literally depopulated the country, and the whole agricultural stock perished; at its close hardly any of the original inhabitants remained or could return. Few villages now existing even pretend to a history which goes back uninterruptedly to a period before this famine, and there is not one which does not date its present form of tenure from the time when cultivation was resumed. Every social relation of the people has its origin subsequent to this fatal era".
 Famine of 1783 A. D.

APPENDIX B-3.

Extracts from District Reports of Famine in the Punjab for the year 1896-97.

HISSAR.

From the 1st of May till the 15th of October barely $3\frac{1}{2}$ inches were registered at head-quarters. The result of these five months of burning heat, varied only by light storms, local in their incidence and capricious beyond the worst traditions even of Hissar, need hardly be described. The following table shows the unirrigated areas sown and cropped during the last four years :—

1				2	3	4	5
Season.				sown. Acreage acres.	matured. Acreage acres.	ACREAGE FAILED.	
						Actual acres.	Percentage on column 2.
Kharif, 1893	...	...	...	1,513,795	1,255,144	258,653	17
Kharif, 1894	...	...	...	1,435,467	933,800	501,667	35
Kharif, 1895	...	...	...	1,422,576	251,014	1,170,964	82
Kharif, 1896	...	...	...	1,269,372	175,631	1,093,631	86

Thus the combined matured areas of the last three years were actually less than the average annual area sown during the same period. The failed area in 1896 was nearly nine-tenths of the whole area sown, and, to make matters worse, the actual yield per acre of matured crops was abnormally light. Most of the jowar and one-third of the bajra were only fit for fodder.....

KARNAL.

The portion of the Karnal district which was affected by famine comprises the tract known as the Nardak in the Karnal and Kaithal tahsils and the Naili tract of the latter tahsil.....The precariousness of its harvests is notorious, and failure of crops reaches the level of famine every seven years. The water-level averages 50 or 100 feet below the surface, and in some it actually reaches 150 feet, which means that the cost of sinking wells is prohibitive, and men and animals alike depend for their drinking water on tanks filled by rain.....In the Naili tract, of which, Jats, Gujars and Ranghars are the chief cultivators, distress may be said to be chronic. The tract has been well said to fluctuate between drought and drowning; in years of heavy rainfall it is subject to the inundations from the Ghaggar and Sarasti; and, owing to an uncontrolled rough-and-ready system of irrigation, by placing dams across the beds of these streams and forcing the water over the banks, a great deal of water-logging and swamping results in wet years, in consequence of which the people have been literally decimated by fever and pneumonia. In dry years this system of irrigation cannot be practised. The result is that years of drowning are preferred to years of drought, as in the former case a bumper rabi generally follows a bad kharif, while in the latter there is neither kharif nor rabi to speak of. The condition of the Naili has been a standing disgrace to us for years, as it could be improved out of recognition by a judicious expenditure of two or three lakhs of rupees on schemes which would be at once drainage and systematic irrigation, while an expenditure of some six lakhs would render the whole district secure.

HISSAR.

.....The following table shows the mortality which was calculated to have occurred between the 1st May 1896 and 31st March 1897, a total of eleven months :—

1				2	3	4	5	6
Tahsil.				Total at last cen- sus March 1895.	Disease.	Starvation or slaughter.	Actual.	Percentage on column 2.
Bhiwani	...	...	...	18,160	597	8,499	9,001	49
Hansi	...	...	...	33,804	1,341	9,179	10,520	31
Hissar	...	...	...	21,638	194	6,803	7,897	36
Fatehabad	...	...	...	39,638	363	27,037	27,450	69
Sirsa	...	...	...	30,548	2,112	20,749	23,501	74
TOTAL				143,680	6,517	71,817	77,184	54

APPENDIX B-3.

These figures relate only to plough cattle, and do not include cows. . . . It will be seen that in the two tahsils with the largest area secured by canals only one-third of the cattle were said to have disappeared. . . .

June was naturally the most trying month of the whole famine. The district was in a condition which it would be almost impossible to exaggerate. The heat by day and night was intense, the tanks were all dry, and, in the case of many villages, the only available water was miles away. Except in the canal tracts, drinking water was found only in scattered brackish wells on the borders of tanks. Nine-tenths of the district was a barren, weary desert. There was no green to break the crushing monotony of the landscape, as even the ever-green jungle bushes were covered with thick dust. The majority of the villages were deserted by a large proportion of their inhabitants, and some villages, chiefly in Sirsa and Fatehabad, were wholly abandoned. During the whole month over one-tenth of the population were in daily receipt of State aid of one kind or another, and the condition of four-tenths more began to give cause for anxiety. Wandering, which had been promptly stopped by the opening of organized relief works in November, began again and we had great difficulty in dealing with it. This habit of drift during the hot weather, if unchecked, invariably leads to great fatality. The people roam aimlessly about from one relief work to another or between the towns and villages in the hope of getting food. They are generally reduced, and liable to succumb rapidly to hunger, thirst or disease. The District Board established posts for storing drinking water on all the main lines of traffic early in May. In June these posts were doubled, and even camel patrols were started, one or two of these animals, in charge of a man, being set to patrol from 10 to 12 miles of road, with pakhals filled at each end of the beat. Certainly travelling by road in the Hissar district in the June of a famine year is not without its dangers, and must be experienced to be realized. In spite of all the precautions taken and the money spent on preventive measures, in the Sirsa tahsil alone, during this month, there were four deaths from thirst on the high roads or in the adjacent jungles.

In regard to the state of the population inhabiting the unirrigated tracts between the Sutlej and the Jumna, the opinions of Mr. Francis for Ferozepore and of Mr. Maconachie for Gurgaon, the resolutions of the Delhi Conference are available. Here the crops fail more frequently than in any other part of the Punjab. But, to counterbalance this, the population of the parts (Ferozepore, Hissar and Rohtak districts) most liable to deficient rainfall and consequent failure of crops are perhaps the most thrifty and enterprising in the Punjab. The holdings are large, there is a large waste area suitable for grazing and the harvests, when sufficient rain falls, yield abundantly. When the worst comes, the agriculturists migrate in search of employment. The people in fact do not regard a bad harvest as anything abnormal, and their mode of life is adjusted so as to best withstand these periodical calamities whenever they do come.

APPENDIX B-4.

Extracts from the Report of the Indian Famine Commission for the year 1893.

Paragraph 12.—During the early months of 1884 the condition of the Southern Punjab, comprising the Karnal, Delhi, Gurgaon, Rohtak and Hissar districts, caused anxiety, and required some measures of relief. Throughout the tract the rainfall of 1883 had been much below the average. The kharif crop promised well up to the middle of July, but a break in the rains lasted for six weeks from the middle of July till the beginning of September, and the greater part of the crop withered. A heavy and general fall of rain in the first week of September rescued some of it, but, generally speaking, the outturn of grain and fodder was very poor. The September rain enabled a considerable area to be sown for rabi, but the winter was rainless, and by March 1884 the unirrigated crops had almost wholly perished. In a great part of the tract the previous harvests also had been poor, and grain stocks had become depleted. But from the rest of the Punjab grain was actively imported, and prices, notwithstanding the local failure of crops, remained low. Barley in March was selling at 26 seers the rupee in the affected districts. The character of the five harvests ending with the rabi of 1884 is shown below in terms of fractions of a rupee 16 annas, or one rupee, representing an average harvest :—

					1882.		1883.		1884.	
					Rabi.	Kharif.	Rabi.	Kharif.	Rabi.	Kharif.
					As.	As.	As.	As.	As.	As.
Delhi	...	...	...	...	12	18	16	5	4	...
Karnal	...	...	...	...	4	8	4	3	4	...
Gurgaon	...	...	...	...	4	12	16	6	8	...
Hissar	...	...	...	...	12	8	12	4	8	...
Rohtak	...	...	...	...	12	8	8	3	4	...

The harvests had been continuously poor in Karnal and Rohtak from 1882, and in these districts the most serious distress was anticipated. The east and south-east of the Karnal district were protected by the Western Jumna Canal, but in the Kaithal and Karnal taluqas there was no rabi crop in most of the villages. Portions of the Rohtak district were also protected by the canal, but in the south, central and western parts of the district which depend on the rainfall, the kharif and rabi failed completely. The condition of the Delhi district was better, as the harvests preceding the kharif of 1883 had been good. In Gurgaon, the people were exceptionally impoverished and indebted, as the effects of the famine of 1876-78, when 150,000 head of cattle died and 50 lakhs' worth of crop were lost, had not disappeared. The position in Hissar was more satisfactory. The cultivators were reported not to have lost heart, and there were no signs of distress.

Paragraph 14.—The largest amount of land revenue suspended was in Rohtak where Rs. 2,20,000 of the kharif demand of 1883 and Rs. 2,23,000 of the rabi demand of 1884 were suspended. In Gurgaon the kharif and rabi suspensions amounted, respectively, to Rs. 1,16,000 and Rs. 1,15,000. In Delhi Rs. 40,000, and in Karnal Rs. 45,000, of the rabi demand was suspended. In Hissar practically the whole demand was realized without coercive processes or hardship to the people. About Rs. 70,000 was advanced for wells, cattle and seed in the four districts.

Paragraph 15.—That this scarcity, arising as it did from a very extensive failure of two successive harvests, which in two districts had been preceded by decidedly poor harvests, should have been tidied over at such small expense to the State, and resulted in so little distress, speaks well of the staying power and resources of the agriculturists of the South-eastern Punjab. The explanation must be sought, partly in the familiarity of the people of this part of the country with drought, and their consequent preparedness for it, partly on the proximity of the canal tracts offering abundant employment to the unemployed and providing surplus grain at low prices and partly in the lightness of the land assessment. The most serious aspect of this, as of other similar scarcities in the South-eastern Punjab, was the great mortality which occurred among the cattle owing to the dearth of fodder and water, especially in the Hissar and Rohtak districts. A proposal to advance 2 lakhs of rupees in these two districts to the agriculturists was made by the Commissioner of the division, but was not supported by the Financial Commissioner, and was ultimately refused by the Local Government. The Financial Commissioner held that it would be cheaper in the end for the people to sell their plough-bullocks at low prices and to buy others when rain began to fall, than to attempt to keep them alive on purchased fodder; and that it would be a great mistake "to encourage the people to run largely into debt for this purpose, when a second

APPENDIX B-4.

failure of the rains would inevitably result in the death of the cattle by starvation". He showed that in those districts the people were in the habit of selling their surplus cattle after harvest operations were over and buying others when required; and argued that it was undesirable to interfere with habits of this kind, which were the result of long experience, in a tract of country where seasons were unusually uncertain. These conclusions were accepted by the Local Government. "As regards cattle required for agricultural purposes", wrote the Government, "it is far better, because it is a far more certain method of relief, to make advances for the purchase of bullocks when the drought ceases, than to make advances nominally to keep them alive during the season of drought. The free suspensions of land revenue which have been made will indirectly enable the agriculturists to procure fodder for their cattle. The people must be left to themselves in this matter; the proceeds of the sale of surplus cattle at the spring fairs will, no doubt, in many cases provide the means of purchasing fodder for the remaining cattle needed for agricultural purposes. Should it be necessary hereafter, the Lieutenant-Governor will be prepared to make large advances for the purchase of cattle."

Paragraph 148.—It was, however, found necessary to give such relief only in the four districts of Hissar, Rohtak, Karnal and Ambala, and, even in these, the numbers so relieved were few compared with the similar figures of other provinces.

Paragraph 149.—Indirect relief was given to the people by the suspension of Rs. 22,00,000 and the remission of Rs. 74,000 of land revenue. In Hissar 50 per cent of land revenue was suspended, and in Rohtak 35 per cent. The relief thus granted in the province is stated by the Local Government to have exceeded the amount granted in any previous famine. Rupees 2,22,149 was advanced under the Land Improvement Loans Act, and Rs. 11,54,490 for seed and cattle under the Agriculturists' Loans Act.

Paragraph 150.—The high water-mark of distress in the Punjab was reached in the month of June 1897, at the end of which month the total number of persons on relief of every kind was close on 100,000. From that date the numbers rapidly declined, and in October relief operations were entirely discontinued.....

	June.	July.	August.	September.
Hissar	78,115	29,815	15,888	8,554
Other Districts	21,018	5,747	2,184	2,084
Total	99,133	35,562	18,072	5,333

Paragraph 151.—In describing the relief operations undertaken in the Punjab, the Local Government has remarked that "if famine be the term applicable to the conditions under which people in considerable numbers accept employment at relief works, rates of wages, then there was famine in nine districts; but severe famine such as visited the worst parts of the North-Western Provinces and the Central Provinces was present perhaps in the Hissar district alone". This accurately describes the conditions of distress which were met with in the Punjab. In a province less prosperous, and among a people less self-reliant and stout-hearted, the extent of crop failure and the dearth of food which were experienced throughout the Punjab would undoubtedly have called for much larger measures of relief. As it was, the relief given appears to have been sufficient. In Hissar alone did the numbers relieved and the expenditure approach the standards of other provinces. Out of a total direct expenditure of Rs. 22,34,000, Rs. 12,27,000 was expended in Hissar.

Paragraph 322, Punjab.—The area affected in the Punjab by the failure of the monsoon rains of 1896 was very extensive, but the situation was greatly improved by opportune rain in December, which permitted cold-weather sowings to be extensively made; and anxiety was subsequently confined to a tract of country in the south-east of the province comprising the greater part of the Hissar district and such portions of the Gurgaon, Delhi, Rohtak, Karnal and Ambala districts as are not protected by the irrigation system of the Western Jumna Canal. In this tract of 10,000 square miles, with a population of 2½ millions, measures of relief on an extensive scale were undertaken, and outside it relief was also required in small portions of the Ferozepore, Lahore and Gujrat districts. The total area in which relief operations were undertaken was 12,000 square miles, with a population of 3½ millions. In Hissar only, where the yield of four successive harvests had not exceeded 25 per cent of an average crop, was the stage of acute famine reached. The famine cannot be said to have been entirely due to the

APPENDIX B-4.

failure of the monsoon of 1896 because relief operations had been found necessary in the preceding spring in the Sharakpur tahsil of the Lahore district, and also in the Phalia tahsil of the Gujrat district in August before it was known that the rains would abruptly cease. But it is probable that, had the monsoon not failed, it would have been unnecessary to undertake any relief measures in the cold weather, and the Phalia relief works would have been closed with the ripening of the autumn crops. The failure or premature cessation of the monsoon of 1896 was, however the main cause which brought about the famine conditions which prevailed in the affected areas. That these conditions were less serious in the Punjab than elsewhere was partly due to the fact that the Punjab had enjoyed a series of excellent harvests from 1892 to 1895, and, despite the indifferent kharif of 1895 and rabi of 1896, the people were in a more favourable position than those of some other provinces to meet the strain in 1896-97.

Paragraph 326.—A noticeable feature of this, as of former famines in the Punjab, has been the great mortality that occurred among cattle caused by the drying up of fodder supplies. As stated in the report, "it will probably never be known to what extent agricultural stock has been depleted during the past two years"; but in the single district of Hissar no less than 77,134, or 54 per cent of the plough cattle are estimated to have disappeared between the 1st May 1896 and the 31st March 1897, a period of 11 months. According to another estimate for the same district "132,325 animals, or 92 per cent of the plough and well cattle of those found to exist in April 1895, disappeared in the two-and-a-half years following". From these figures may be formed some idea of the distress and suffering to cattle and the resulting loss to cultivators. The measures adopted by the Local Government to mitigate this loss by the opening to grazing of Government forests seem to have been as full as circumstances permitted.

Paragraph 329.—.....As previously stated, severe famine conditions were practically confined to the Hissar district, and the truth of this is fully confirmed by an examination of the vital statistics. Whilst Hissar was the only district in which there was a marked falling off in the birth-rate, so it was the district in which the death-rate in 1897 was most in excess of the normal rate. In Hissar the death-rate rose from 30.3, the mean of the five-year period 1891-95, to 45.0 in 1897—an increase of 14.7 per mille.....

Paragraph 339.—The famine of 1896-97 affected an area of about 225,000 square miles in British India and a population of 62 millions. The area which was severely affected, and to which relief operations were chiefly confined, may be put roughly at 125,000 square miles, with a population of 34 millions. In the direct relief of distress, apart from loans and advances to landholders and cultivators and remissions of land revenue, 727 lakhs of rupees (Rs. 72,70,000) were expended by the State.

Paragraph 411.—... The Irrigation Department is, no doubt, concerned to show as high a return as possible on its protective and minor irrigation works, but the primary justification for grants under these heads is not that the works constructed under them will prove directly remunerative, but that they will strengthen the agricultural community and mitigate distress in future.

Paragraph 538.—... It may, we think, be added that, as the bulk of the revenue and of the special taxes imposed in 1878 is paid by the holders and occupiers of land, and as the State in India is generally in the position of superior landlord, there are special reasons why Government should undertake without expectation of direct return works peculiarly protective of agriculture, such as irrigation works.

Paragraph 540.—"Viewing the provision of irrigation works as a means of affording an insurance against drought, Government may, we think, properly regard them as a class of undertakings which should be treated as a whole, so that any unusual facilities obtained in one direction may be set off against special difficulties in another, and the general financial outcome of the entire class may be accepted as a sufficient test of the policy that should regulate their treatment. Thus considered, and bearing in mind that it has never been the desire of Government to manage these works with a view to show great profits, the actual results which have been stated appear to us entirely satisfactory, and such as to justify their continued prosecution with all suitable precaution to ensure economy of construction."

Paragraph 593.—In the territories of Native States the area affected by famine or scarcity in 1896-97 was returned at 82,000 square miles, with a population of 7 millions. It comprised the Bikaner, Bharatpur and Dholpur States in Rajputana.....

APPENDIX B-5.

Extract from the Evidence of Witnesses from the Punjab taken before the Indian Famine Commission for the year 1898.

3. (a) The causes which led to the famine have been described at length in the report on famine relief operations in the Hissar district, and from the statistics given in that report some idea may be formed of the extent to which distress prevailed. Four persons died from the immediate effects of thirst, and all four of these belonged to one or other of the Native States on the border. During the hot-weather months we had an extensive system of water-supply for travellers all over the district, but this was known only to residents of British territory. Immigrants did not know where to look for water. Considering therefore the magnitude of the distress in Hissar, the peculiar physical difficulties of the country and the number of emaciated immigrants from Native States, we may claim that the efforts to save life were highly successful.

Captain Dunlop-Smith.

Paragraph 4.—...In Hissar, famine always begins after the failure of a kharif harvest. The rabi crop is too unimportant to have much effect one way or another on a famine.....

Was there any other cheap food that the people could get besides cheap meats to supplement their diet with? Yes, jungle berries.....Latterly, when the rains did come, the people used a great many natural grasses that sprang up.....

The water-level for the greater part of Hissar is so low that they cannot make wells It runs up to 200 feet, and even then the water is brackish....

Have you verified the statement made by you, namely, that only 15 per cent of the plough and well cattle were left in the district? Yes, it is according to data at my command....

Paragraph 4.—Sufficiency and economy of the relief measures. My experience in the late famine was that the percentage of the population of the affected tracts in the Hissar district who sought relief during the worst months of the famine ran up to 18 per cent, while for the Sirsa tahsil alone the proportion was as high as 25 per cent.....

Mr. Floyd.

Was there a considerable loss of cattle? Not to the same extent as in Hissar, but large numbers perished. In some villages there was not drinking water? This was the case.

Mr. Connolly, Deputy Commissioner,
Karnal.

APPENDIX B-6.

Extracts from the Punjab Famine Report of 1899-1900, Volume I.
Government Resolution.

Paragraph 4.—.....The districts in which the most extensive failures of crops occurred were Hissar, Rohtak, Gurgaon, Karnal and Ambala, all in the Delhi Division.

Paragraph 5.—As in previous famines, the immigration of multitudes of persons from Bikaner and other Native States was an early indication of coming trouble, and early in September 1899 the Lieutenant-Governor drew the attention of the Government of India to the fact that in the previous month 20,000 wanderers had entered the Province, and suggested that earthwork might be started on the Bikaner-Bhatinda Railway within the Bikaner border.....

Paragraph 6.—In the Rohtak district measures for the relief of distress had been found necessary as early as the beginning of the summer of 1899.....

Paragraph 8.—The whole of the unirrigated area of Hissar, 3,763 square miles in extent, with a population 543,834, was affected by the famine, the total area of the district being 5,188 square miles and its population 776,006.

Paragraph 11.—.....The maximum number under relief which was reached on 17th March was 7 per cent of this population.

Paragraph 13.—The whole of the Ambala district except the valleys of the Sutlej, Ghaggar, Son and Jumna and narrow strips along hill-streams, suffered from agricultural distress and general tightness; but, though the area affected included 1,050 square miles, State relief was not found to be required on a large scale.....

Paragraph 28.—.....At the Jahazgarh Cattle Fair in September 1899, Rohtak cattle to the number of 52,135 were sold at an average price of Rs. 14-2-0 a head. At the Hallifax Cattle Fair in Gurgaon, 15,430 head of cattle were sold between January and September 1900 at an average cost of Rs. 9 a head. At the Rewari Fair better prices were realized, the average being Rs. 23-8-0 a head for a total of 13,809 sold. In Shahpur, as in Hissar, a bullock or cow could be bought for the price of the hide, Rs. 3 to Rs. 5. The export of hides from Hissar during the year ending 30th September 1900 amounted to 78,633; 58,502 maunds of bones were exported in the same period. In the Delhi Division, where the famine area was extensive and continuous, fodder could not be imported, except from a great distance and at a prohibitive expense; and the multitudes suffering for want of food could not afford to pay for fodder. In the west of the Province great keenness was shown by stock-owners to import fodder from wherever it could be procured, and from the Chenab Colony there was a large export of bhusa, which had been produced abundantly in the rabi harvest of 1899, and which must have yielded a handsome profit to the colonists. The Lieutenant-Governor had at one time under consideration a scheme for purchasing bhusa on a large scale at Lyallpur, compressing it there and transporting it to the districts affected by famine or scarcity, but it was found that the cost was more than the owners of stock could afford to pay and more than Government would have been justified in incurring for the sake of a gain represented by the value of the cattle saved.

Paragraph 51.—.....The total number of deaths from all causes during the eight months' period was in Hissar 42,300 and in Rohtak 23,204, compared with an average mortality in the same period of 15,137 and 11,117, respectively. A feature of the mortality statistics of both districts is the proportionately fewer number of infants under one year who died in the famine year as compared with the average of 1891-95. In Hissar these formed only 14 per cent of the total number of victims as compared with an average of 24 per cent. In Rohtak the corresponding percentages are 18 and 27. This is explained by the fact, which is also brought out by the Sanitary Commissioner's returns, that a great diminution occurred in the number of births in the famine year.

Paragraph 56.—The Sanitary Commissioner gives prominence to the fact that the increase in the mortality was in proportion to the severity with which the famine visited the three districts of which he has examined the statistics more particularly. Thus in Hissar, where the famine was most severe, the number of deaths was nearly three times the average; in Rohtak, which suffered less severely, the number was twice the average; and in Gurgaon, which was not very severely affected, the mortality was less than 50 per cent above the average (17,927 compared with 12,888).

APPENDIX B-7.

Extracts from the Famine Report of the Hissar District for the years 1899-1900.

Paragraph 33—The point which would perhaps strike the ordinary outsider first in comparing the present famine with the last is that prices were, comparatively speaking, easy during the whole time and, except during the last few weeks, never approached to what might be considered typical famine rates. The question then not unnaturally arises: If that is the case, how is it that the famine was so much more severe than the previous one, and consequently the number on relief so immensely larger? The answer is not far to seek. The price of food had very little to do with the severity of the famine because the people had nothing wherewith to buy, no matter what the prices might be. All their resources had been drained by the previous famine, and the zamindars had absolutely no stocks of food or fodder left.

Major Dunlop-Smith, in his final report on the 1896-97 famine, says "When the famine began, the stores of the agriculturists and the dealers must have contained enough to feed the total population of the district for 16 months. There is ample evidence that this valuable reserve is quite exhausted; and, if the people wish to replenish it to the average standard, they will have to refrain from all exports and put by every surplus grain for the next five harvests. I am of opinion, however, that it will take at least five good years before the local stocks even approach their old figure".

Paragraph 72.—... During the famine of 1896-97 it appears to have been more or less the rule that one or more members of a family should stay at home and look after the cattle and the property while the rest went on the relief works, but it was not so during the present famine; then whole families came on the works; there was nothing to look after in the village and no fodder for the cattle. This is not merely a conjecture, but a fact which was apparent to anyone touring in the villages. In the barani tracts the majority of houses in each village were shut up and the doors closed by a bundle of thorns, which gave the villages a most forlorn appearance, which was enhanced by the gaunt and mournful appearance of the few people remaining....

Sub-paragraph 3—The present famine has by its severity caused an unprecedented loosening of family ties. Husbands deserted their wives and children and went off to other and more prosperous regions, leaving their families deprived of their bread-winners, to do the best they could with the assistance Government could give them. Similarly people deserted their children and their old folk in the most heartless way.

Paragraph 100.—... Major Dunlop-Smith says in his report on the famine operations of 1896-97 that it was only in April 1897 that the general health of the district began to be affected. We were not so fortunate in the present famine for, after an unusually healthy September, October and November, the death-rate began to rise in December 1899 and went smartly up until it reached its climax in April 1900, when it stood at 124·5 per mille....

Paragraph 117.—... During the famine the question was often raised whether it would not on the whole be cheaper to let the cattle die and help the people to buy new stock when the famine was over. It seems to me to be hardly fair to view the question in this bald way and that where the scarcity is intense over a large area, as it was in the present case, such a policy would be fatal and much lasting damage done by letting valuable breeds become extinct or nearly so....

Paragraph 118.—With such a manifestly inadequate stock of plough cattle in the district on the ending of the famine it became a very serious question as to how the people were to till the land. There was very little prospect of any sufficient number of cattle from outside being available. Most fortunately for the district the rains were partial, and allowed of ploughing being extended over a much longer period than would have been the case had rain fallen at once all over the district. People were accordingly able to let their cattle out on hire and to plough for their friends. The rate of hire went as high as Rs. 3 per day for a plough. A certain number of cattle were brought into the district by dealers from other parts, including a considerable number from Patiala, and these helped to supply the deficiency. It is estimated that on the whole three-quarters of an average crop were sown for the kharif 1900, but it seems highly probable that, but for the partial nature of the rains, late as they were, a still smaller area would have been sown owing to the want of plough cattle to till the land.

Paragraph 120.—Two Rajput brothers in a Bhiwani village were supposed to be well off, and lived in a masonry house valued at about Rs. 2,000. Three years ago they owned 8 bullocks, 10 milch buffaloes and 40 cows and calves. All their cattle died from want of proper food, and they had to dispose of everything to keep themselves and their families from starvation. Another family of Rajputs owned land and a large number of cattle, some 70 head, but all their cattle have died, and they had to mortgage half of their land. They got a gift of Rs. 30 from the charitable fund, and were able to sow a little land by borrowing cattle from their neighbours....

APPENDIX B-7.

Paragraph 121.— . . . Besides the ordinary food-stuffs, the people of the lower classes in villages and even the zamindars in the bad days of the famine used to use the leaves and powdered bark of the jand tree. The bark was ground up and mixed with flour, and so cooked and eaten along with the boiled leaves. . . .

Paragraph 123.— . . . It was a matter of common knowledge that bullocks could be purchased during the famine for prices varying from Rs. 2 upwards and averaging Rs. 2-8-0 to Rs. 3, whereas the skin of the animal, when dead, was worth about Rs. 4, so that the butchers gained Re. 1 to Re. 1-8-0 on the transaction, and had the meat as well to dispose of . . .

Paragraph 124.—I have already shown in Chapter XIV that the closing of the famine found the district indebted to Government to the extent of something like three and a half times its yearly revenue. The prospects of the district. In addition to this, with the exception of some few people who made profit out of their neighbour's adversity, the great bulk of the people, moneyed classes, landlords and tenants are at the end of their resources, and the cultivators have lost nearly one-half of their necessary livestock, to say nothing of the whole of their surplus stock. We have also seen that the area of encumbered land has gone on steadily increasing for the last four years. It will thus be evident that the district must be treated very gently until better times come . . .

APPENDIX B-8.

Extracts from the report of the Indian Famine Commission for the year 1901.

Paragraph 200.—Only five districts in the Punjab were affected, and in all, except Hissar, the conditions were rather those of scarcity than of famine. In Hissar the death-rate was excessively high, and in Rohtak and Karnal it was very great. The following are the death-rates *per mile* for the year 1900 :—

DISTRICT.	SMALL POX.		FEVER.		DIARRHOEA AND DYSENTERY.		CHOLERA.		ALL CAUSES.	
	1900.	Decennial average.	1900.	Decennial average.	1900.	Decennial average.	1900.	Decennial average.	1900.	Decennial average.
Hissar ...	1.7	.9	70.0	21.1	8.6	.7	8.3	.8	96	28
Rohtak. ...	.6	.3	51.8	22.4	1.6	.0	3.5	.7	68	31
Gurgaon ..	2.5	1.1	32.2	25.8	2.9	1.8	1.7	.4	50	37
Delhi ...	.5	.4	84.1	27.4	2.6	1.7	.6	.6	54	43
Karnal ...	.2	.8	55.4	19.8	1.8	.7	2.0	.8	74	31

Paragraph 201.—A special inquiry regarding the death-rates in Hissar and Rohtak elicited the fact that the fever in the early months of the year was of a non-malarial type, and was aggravated by famine conditions.

Paragraph 205.—The great mortality of cattle in the recent famine has pushed to the front the question of their preservation in times of drought and dearth of fodder. Such fodder famines are fortunately rare. In an ordinary famine, when the crops fail at a late stage of their growth, there usually remain sufficient straw and grass to save, at any rate, the useful cattle; but the recent famine has been abnormal in this respect. . . . Nor was this mortality confined to the useless cattle; valuable bullocks and breeding cattle have perished in thousands, involving a loss to agriculturists, from which, even with the liberal assistance of Government, it will take them long to recover

Paragraph 206.— And yet the cattle died in immense numbers. Much of this mortality was doubtless due to a deficient and polluted water-supply, but much was directly attributable to the generally unfavourable conditions which prevail in times of famine.

Paragraph 208.—In spite, however, of this discouraging experience, we are strongly of opinion that in future strenuous attempts should be made to save at least the valuable cattle; and the experiments made in the recent famine, if they have not given results commensurate with the expenditure, encourage the hope that by systematic and well-directed action much may be done.

Paragraph 210.—Growth of fodder crops.—We attach special importance to this remedy not only because the fodder grown on the spot is much more valuable than the stuff imported but because it has the collateral advantages of saving the cost of transport, of avoiding delays, of employing local labour and of keeping the cattle at home

Paragraph 248.—In the Punjab the question of remissions is usually held over for three years, the local officers meanwhile collecting what they can from harvest to harvest. At the end of three years the balance outstanding is usually remitted. We are aware that in precarious districts like Hissar the revenue is so extremely light that a good crop leaves a margin sufficient to pay off extensive arrears. But we are none the less of opinion that uncertainty in the demand is a great evil; and we gather that the discretion left to local officers in Hissar resulted in the collection of arrears between the two famines which the district was not really able to pay.

Paragraph 351.— For storage tanks, reservoirs and, above all, irrigation wells, the scope and the necessity are very great. As the whole subject of irrigation has now been taken up by the Government of India in pursuance of the recommendations of the Commission of 1898, we need do no more than point to the confirmation which our inquiries afford to the conclusions of the last Commission, and express our cordial approval of a new departure in famine policy which would place irrigation works in the place that protective railways have hitherto occupied in the famine insurance programme

APPENDIX B-9.

APPENDIX

Statement showing the losses of cattle in

Serial No.	Name of district.	Bulls and bullocks.	Cows.	Male buffaloes.	Cow buffaloes.	Young stock of both sexes.
1	2	3	4	5	6	7
1	AMBALA DISTRICT.					
	February 1899 ...	182,653	104,127	2,902	85,069	138,302
	As per census of August 1900 ...	155,333	83,160	1,863	72,299	114,037
	Loss ...	27,320	20,967	1,037	12,790	23,425
2	KARNAL DISTRICT.					
	February 1899 ...	198,435	143,386	5,489	168,167	210,199
	As per census of 1900 ...	168,640	122,662	3,451	131,721	160,936
	Loss ...	29,795	20,724	2,038	36,446	65,263
3	DELHI DISTRICT.					
	February 1899 ...	42,335	11,663	Included under Bulls and Bullocks.	20,565	41,639
	As per census of 1900 ...	32,409	27,643		14,019	21,145
	Loss ...	9,926	11,010	...	6,546	17,494
4	GURGAON DISTRICT.					
	February 1899 ...	129,356	115,747	1,619	59,439	125,629
	As per census of 1900 ...	89,005	65,622	891	57,306	61,152
	Loss ...	40,350	50,125	728	22,133	64,597
5	ROHTAK DISTRICT.					
	February 1899 ...	63,669	62,779	Included under Bulls and Bullocks.	Included under Cows.	60,811
	As per census of 1900 ...	43,787	30,906			27,215
	Loss ...	19,722	32,773	...	...	39,600
6	HISSAR DISTRICT.					
	February 1899 ...	111,034	111,432	2,119	63,500	161,035
	As per census of 1900 ...	55,611	55,099	600	35,455	89,285
	Loss ...	55,420	56,333	1,519	28,045	71,750
	Purchased from outside meanwhile ...	19,029	6,036	266	5,463	8,297
	As per census in November 1900 ...	70,180	56,463	820	30,593	90,668
	Total Loss ...	59,913	61,925	1,565	30,350	78,669
	TOTAL OF ALL DISTRICTS.					
	February 1899 ...	746,281	605,050	12,425	402,223	757,876
	As per census of 1900 ...	530,361	355,356	7,027	294,018	469,033
	Total loss in 6 districts ...	186,920	220,624	5,398	108,205	288,842
	Add as per note regarding Rohtak District ...	...	...	...	...	...
	GRAND TOTAL ...	...	...	...	...	...

APPENDIX B-9.

the Delhi Division during the Famine of 1899-1900.

Sheep.	Goats.	Horses and ponies.	Mules.	Donkeys.	Camels.	TOTAL.	Per cent.	REMARKS.
8	9	10	11	12	13	14	15	16
47,523	103,343	9,496	1,331	8,955	891	687,677	...	
44,858	103,921	6,480	582	7,876	673	591,994	...	
2,665	2,427	3,016	789	1,079	218	95,683	14	
66,921	99,217	12,771	915	17,328	1,019	930,347	...	
38,730	51,903	6,554	658	9,016	359	684,596	...	
28,191	47,254	6,217	257	8,212	1,260	245,751	26	
			Not given.			145,992	...	
						98,116	...	
						47,876	33	
Not given separately; included under "Goats".	2,03,280		Not given.		1,577	636,877	...	
	1,34,750				778	389,575	...	
...	68,580	...	...	...	1,099	247,302	39	
*The figures "Other Cattle" are put under this head as there is no further distinction given.						218,099	...	
						101,008	...	
...	...	...	...	...	...	112,491	53	
151,607	1,86,056	7,094	98	13,858	32,256	841,002	...	Total among the distressed villages—Loss for the whole district amounts to 138,263.
49,530	1,01,877	3,992	55	7,981	25,062	424,292	...	
102,331	84,179	4,002	43	5,877	7,194	416,710	...	
15,023	4,958	457	4	717	5,097	66,247	...	
60,691	100,704	3,940	57	8,238	28,079	459,023	...	
106,199	99,310	4,211	45	6,337	8,074	448,320	53	
261,334	599,859	30,418	2,343	40,758	41,740	8,521,341	...	
144,270	391,338	10,974	1,807	25,130	30,489	3,324,313	...	
137,055	208,521	18,444	1,041	15,628	11,251	1,196,929	34	
...	...	...	...	...	...	26,172	...	
...	...	...	...	...	...	1,223,101		

APPENDIX C-1.

Note, dated 14th March 1917, by H. W. Nicholson, Esquire, Executive Engineer, Project Division, Sirhind Canal, on price of locally manufactured Portland Cement which would be such as to make its use general in the Punjab and justify opening of manufacture operations on a large scale.

	Rs. A. P.
1. <i>Cost of white lime mortar 100 c.ft.</i> —One maund of lime at annas 14 maund at Railway Station, say Re. 1 maund stock rate in godown on Canal works, 1 maund lime gives 2 c. ft. of slaked lime. Hence pure lime mortar per 10 c. ft.=	50 0 0

with 2 white lime to 3 surkhi.—Surkhi rate may be taken at Rs. 21 per cent (in small quantities from surplus bye-product of kilns it might be got for less)—

100 c. ft. mortar=10 c. ft. white lime at Rs. 50%=	20 0 0
60 c. ft. surkhi at Rs. 21%=	12 10 0
	32 10 0

with 1 white lime to 2 of sand—

	Rs. A. P.
33 c. ft. lime at Rs. 50%=	16 11 0
66 c. ft. sand at Rs. 6%=	4 0 0
	20 11 0

Kankar lime.—

100 c. ft. cost not less than Rs. 45-0-0.

Stock rate on Upper Jhelum Canal, at Rupar where there are the best deposits in the Province with 9 miles carriage the rate is Rs. 30 per hundred c. ft.

	Rs. A. P.
Neat Kankar lime mortar	45 0 0
3 parts kankar lime mixed with 2 surkhi and 1 white lime—	
50 c. ft. kankar lime at Rs. 45%	22 8 0
33.4 surkhi at Rs. 21%	7 0 0
16.6 white lime at Rs. 50%	8 5 4
	37 13 4

APPENDIX C-1.

The cheapest mortar of any, white lime and sand costs Rs. 20-11-0 per hundred cubic feet, say Rs. 21 and this is hardly ever used in the Canal Department.

The cheapest mortar used is white lime and surkhi costing Rs. 32-10-0, say Rs. 33 per hundred cubic feet. The cheapest hydraulic mortar used is kankar lime, surkhi and white lime costing Rs. 37-13-4, say Rs. 36.

No allowance has been made in the above rates for grinding the mortar in mortar pans, this would increase the rates by about Rs. 4 per hundred cubic feet.

2. Now the question is what is the fair rate for Portland Cement to enable it generally to displace other mortars? This can be worked backwards.

First take the highest rate paid for 1st class mortar at present, *Hydraulic Mortar* at Rs. 38-4 for grinding and mixing = Rs. 42 per hundred c. ft.

This would be replaced by a 1 Portland Cement to 2 of sand in the best work, down to 1 to 3 of sand in ordinary work or to 1 to 4 in Foundation work or coarse concrete of 1 : 4 : 8 mixture.

If a 1 Portland Cement 2 sand is to be equal in cost to a Rs. 42 per hundred cubic feet Hydraulic mortar assuming no contraction (as a matter of fact Portland Cement is so finely ground it settles into the spaces of the sand far more than lime does)—

	Rs.	A.	P.
66 c. ft. of sand at	4	0	0
∴ 33 c. ft. of Portland Cement should cost Rs. 42			
minus Rs. 4	38	0	0
∴ 100 c. ft. of Portland Cement cost Rs. 38 × 3...	114	0	0

Now 1 barrel of Portland Cement = 360 lbs. net or 4 c. ft.

100 c. ft. Portland Cement = 25 barrels, cost per barrel at site of work should be

$$\frac{\text{Rs. } 114}{25} = 4.56 \text{ Rupees per barrel.}$$

Rs. 114 = cost of 100 c. ft.

$$= \frac{100 \times 90}{2,240} = \frac{9,000}{2,240} \text{ tons}$$

therefore 1 ton should cost at site $\frac{114 \times 2,240}{9,000} = 28.4 \text{ Rs. per ton.}$

Take again the cost of a mortar of white lime and surkhi at Rs. 32-10-0 per hundred cubic feet and Rs. 4 for grinding, costing Rs. 36-10-0 per hundred cubic feet as being replaced by a 1 Portland Cement to 3 sand mortar with no shrinkage allowance.

	Rs.	A.	P.
100 c. ft. mortar cost	30	10	0
75 c. ft. sand at Rs. 6%	4	8	0
therefore cost of 25 c. ft. Portland Cement should be			
Rs. 36-10-0 minus Rs. 4-8-0	32	2	0
Cost 100 c. ft. of Portland Cement $\frac{100}{4}$, i. e., 25			
barrels or $\frac{100 \times 90}{2,240}$ tons	128	8	0

$$\text{Cost per barrel Rs. } \frac{128-8-0}{25} = 5.14 \text{ per barrel.}$$

$$\text{Cost per ton Rs. } 128-8-0 \times \frac{2,240}{9,000} = 31.9 \text{ Rs. a ton.}$$

APPENDIX C-1.

Finally take the cheapest mortar of all, *white lim. and sand* at Rs. 20-11-0 per hundred cubic feet and assume it is not ground and replace by 1 Portland Cement to 4 sand mortar—

	Rs.	A.	P.
100 c. ft. mortar cost	20	11	0
80 c. ft. sand at Rs 6%	4	13	0
∴ Cost of 20 c. ft. of Portland should be Rs. 16-14-0, i. e., Rs. 21-11-0—4-13-0			
∴ 100 c. ft of Portland Cement $\frac{100}{4} = 25$ barrels			
$\frac{100 \times 90}{2,240}$ tons	84	6	0

Cost per barrel Rs $\frac{84-6-0}{25} =$ Rs. 3-38 per barrel.

Cost per ton Rs. 84-6-0 $\times \frac{2,240}{9,000} =$ Rs. 21-0 per ton.

The above figures show what price of Portland Cement in stock at site of works would enable it to compete with ordinary mortars.

Owing to the price of Portland Cement in England having become so low of late years to enable it to compete with ordinary mortars, it is rare to see lime mortar used other than in Jerry Building.

3. Taking the question of what cost of Portland Cement would make it possible to use it generally throughout the Province for lining canals and small channels.

Two conditions come forward—

- A. Lining existing channels.
- B. Lining new channels.

In case A there are further differences to consider—

- (a) If the tract is waterlogged or not.
- (b) If the channel is subject to rotational working or not.

The question of cost of cement affecting the financial possibility of carrying out the work on a running canal in the head reaches is not such a weighty factor as the cost of unwatering, laying, etc., under the difficult conditions which exist.

In the lining of branches and distributaries the cost of the cement becomes the main factor.

I have not worked out any costs for running canals, and no reliable accepted data exist to shew losses on distributaries.

4. With regard to the Sirhind Storage Project the question has been dealt with as follows :—

- Assumptions*—(1) Loss by absorption 8 cusecs per million square feet wetted perimeter in unlined channels.
- (2) Loss after lining with concrete at bed 2 cusecs per million.
- (3) Value of Kutter's N earthen channel .0225 reduced by Portland Cement concrete lining to .015.
- (4) Value of 1 cusec saved 2,000 Rupees per annum.
- (5) Capital value of 1 cusec taken at 25 years' purchase.

Advantage is taken of reduction of section of channel required owing to decrease in rugosity and the possibility of increasing the bed slope to give velocities greater than those permissible in earthen channels.

APPENDIX C-1.

No credit has been taken for saving in cost of masonry works such as bridges and falls owing to decreased bed width.—

Case 1—

Channel to carry 8,000 cusecs.

Earthen, slope 1 in 8,000.

Permissible expenditure on lining on assumption given above Rs. 48-8-6 per hundred sq. feet.

The velocity is increased from 3.34 feet run per second or .91 Vo. to 4.69 or 1.28 Vo.

Case 2—

Channel to carry 4,120 cusecs.

Slope 1 in 6,666 unlined; 1 in 5,000 or 1 in 1,000 lined.

Permissible expenditure on lining on assumptions given above Rs. 56-4-0 per hundred ft. slope 1 in 5,000, or 63 per hundred s. ft., 1 in 4,000.

Velocity increased from 3.12 feet per second = .98 Vo. to 5.03 feet per second = 1.58 Vo. slope 1 in 5,000, and 5.55 feet per second = 1.74 Vo. slope 1 in 4,000.

Case 3—

Channel to carry 2,770 cusecs

Slope 1 in 6,666 unlined, 1 in 5,000 and 1 in 4,000 lined.

Permissible expenditure on lining on assumptions given above Rs. 55-8-0 slope 1 in 5,000.
Rs. 63-4-0 slope 1 in 4,000.

Velocity increased from = 2.82 feet per second = .97 Vo. to 4.62 feet per second = 1.58 Vo. 1 in 5,000, or 5.11 feet per second or 1.75 Vo. slope 1 in 4,000.

5. The above figures are very conservative, the value of 1 cusec having been taken at 2,000 Rupees whereas in the Administration Report of the Province the potential value was given at over 8,000 Rupees per annum.

Further the water rates taken per acre are so low at present that they can undoubtedly bear a great increase.

Thus the water rate for wheat per acre only represents $1\frac{1}{2}$ to $1\frac{3}{4}$ maunds of produce per acre on the most highly assessed canals. The rate for sugarcane is only Rs. 7-3-0 to Rs. 10 an acre, whereas in Bombay it rises to Rs. 40 per acre.

In view therefore of the absolute impossibility of arriving at any exact estimate of the expenditure permissible on lining which is in any way commensurate with the benefit accruing therefrom some approximate figure must be taken. The most conservative figure possible has been postulated, viz., 50 per cent square feet lining in new channels running over 2,000 cusecs.

6. Having arrived at this figure the question arises as to the nature of the concrete lining to be used.

It may be of a uniform rich quality concrete or in the form of a thick backing of leaner concrete worked up to a plastered face. Of the above two methods it cannot be said which will be the most efficient, taking into account considerations of costs.

At any rate to assume a 6" layer of 1 : 2 : 4 Bajri Ballast concrete is equal to the best American practice and on that basis 100 square feet of 6" concrete lining laid could cost Rs. 50 per hundred square feet or Rs. 100 per hundred cubic feet. The problem for solution then is, can Portland Cement be manufactured and delivered at site at such a rate that will enable the Portland Cement concrete to be laid complete at a rate below the above figure? Twenty-five per cent for Establishment charges is to be included.

On the Ganges bridge the masonry of the wells was built of a 1 : 3 : 6 concrete artificial stones (cement being imported from England) at a rate

APPENDIX C-1.

of 60 per hundred cubic feet concrete in mould yard on river bank and Rs. 100 per hundred cubic feet built into the wells works charges only.

7. The question now comes of the future Portland Cement manufacture in India.

In America where large irrigation works are carried out in remote spots special cement factories are established at or near the site to supply cement for the one work during construction only.

The first step in India was a concession granted by the Punjab Government at the instance of Sir Louis Dane to a Company for manufacturing cement in the Salt Range, the conditions were very favourable to the Company and it was agreed that the Punjab Government would take all cement from the Company only, for 10 years, at a fixed high price. Fortunately the Company failed to develop and the Province is free to get its cement in the cheapest market.

Since the concession in the Punjab was given, cement factories have opened at Bundi and Katni and they turn out cement in every way satisfactory. The only point is that they are out to make money and take advantage of lack of competition and only just undersell the home product so as to make as large a profit as possible. It may be said that their profits are not large, but there is no reason to assume when the conditions for materials are more favourable than at home on the Medway, and Indian labour is so cheap, that the cost of manufacture out here is higher than at home. During the War owing to difficulty in getting parts, etc., for the plant costs may be more than usual.

Prior to the War conditions becoming acute cement was quoted by them in large consignments for Rs. 56 a ton equivalent to (1 ton = $2\frac{3}{4}$ barrel say $6\frac{1}{2}$ barrels) $56 \div 6\frac{1}{2}$ a little less than 9 rupees a barrel delivered at Doraha Station on the Sirhind Canal, this was a distinct improvement on any rate that had been obtained before. The stock rate for English cement in Ludhiana Division varies from Rs. 12-4-0 to Rs. 12-12 0 per barrel. Probably the price at Katni is high owing to the cost of carriage of coal to the works; certainly it is long Railway haul from Katni to the Punjab.

8. The question is, cannot manufacture be carried out in the Punjab? There is no doubt that a cheap cement would develop a market; earlier it has been shown what rates would enable it to compete with kankar and white lime purely on a question of relative cost apart from its greater strength enabling lighter walls to be built.

Further in addition to the general market there is the intense demand of the Irrigation Department for a cement at such a price that will enable cement lining of old canals to be undertaken. Were cement to be manufactured to meet this demand, the outturn required would be enormous. As an indication it may be mentioned that the wetted areas of the Main Line and Branches of 8 of the Canals are as follows :—

		<i>Millions square feet.</i>
Upper Bari Doab Canal	...	1,23
Sirhind Canal	...	1,84
Lower Chenab Canal	...	1,76
		—
		4,33
		—

Assuming a 6" lining, that gives 217,000,000 cubic feet of concrete required or with a 1 : 2 : 4 concrete about 50,000,000 cubic feet of cement or 12 million barrels. This would be the requirements to line only the Main Line and Branches of three of the 8 existing major canals and takes no account of construction in the near future.

9. The whole Punjab is more or less an alluvial plain starting from the Himalayas relieved by the Salt Range as a geological museum.

APPENDIX C-1.

A cement factory in the Salt Range is a possibility and probably would be more advantageously placed than Katni in having fuel at hand although the materials might not be so conveniently available.

10. Again oil has been discovered at Attock and North-West Frontier Province and across the Frontier in tribal territory and is being prospected in the Province, and oil forms a cheap and efficient fuel easily transportable to any centre in the Punjab where the materials are available for cement.

It is believed that Patiala granted a concession for Portland Cement manufacture at or near Chandigarh below Kalka but nothing has so far developed. There may be other sites in the foot hills of the Himalayas where the materials exist. The Kroll Hill near Barog Station on the Kalka-Simla Railway is said to contain all the materials necessary for cement manufacture in natural deposits as at Katni.

11. There is no doubt that the question of a supply in the Punjab of high class Portland Cement at a rate comparable with the price in England is one which strongly affects the future material progress and prosperity of the Province.

It is not known if the Geological Survey of India Department have been consulted, but it would appear to be desirable to consult them first to avoid unnecessary time and labour being wasted in considering proposals which did not take into account all the available information.

12. The price of Portland Cement in America varies from Rs. 3.3 to Rs. 4.8 per barrel and if it could be obtained in the Punjab at or near that price the whole aspect of Civil and Irrigation Works would be revolutionized.

An appendix (C-2) is given shewing the cost of lining laid in America on the Franklin Canal, obtained from Engineering News of 10th September 1914. The rates come within that as shewn to be possible above, but there is no doubt with the cheaper labour available in India that these rates could be much reduced if cement were available at a similar rate.

13. It was stated in paragraph 7 that the stock rate for Portland Cement in Ludhiana Division was Rs. 12-4-0 to Rs. 12-12-0 per barrel.

The cost in England entered in Indents was 6 shillings per barrel or Rs. 4-8-0. The debits accepted in 1912 amounted to Rs. 4-6-6 and Rs. 4-7-0 per barrel. The cost of a barrel as given in Government of India Circular 3 P. W. of 6th April 1913 is 1/10 to 2/- shillings or Re. 1-6-0 to Re. 1-8-0. The cost of the cement in England a barrel is therefore Rs. 4-8-0 less Re. 1-8-0, say Rs. 3. A barrel contains a cubic feet 360 lbs net, so the cost per ton F.O.B. in England of the cement without barrel is $\text{Rs. } 3 \times \frac{2,240}{360} = 18.66$ Rupees a ton.

This is practically the same as the figure of 24 shillings a ton (Rs. 18) which I carry in my head from English experience in the Admiralty.

14. It is therefore perfectly plain from paragraph 2 above that if cement were put on the market in the Punjab at a price approximating to the English price it would hold the market against all other limes and make concrete lining of channels a very remunerative proposition.

15. The benefit of lining has only been calculated on the cost of water saved, no value can be assigned to the damage caused by waterlogging throwing land out of cultivation or deterioration to the health of the people.

There is further the saving of the necessity of making expensive endeavours to cure waterlogging by drainage and pumping, none of which are productive and place a heavy financial burden on the canal systems.

H. W. NICHOLSON, B.Sc., A.M.I.O.E.,
Executive Engineer, Project Division, Sirhind Canal.

APPENDIX C-2.

Details of concrete lining Franklin Canal, Rio Grande
(Engineering News of 10th September 1914).

				Rs.	A.	P.
Labour per 8 hours day	...	...	...	3	12	0
Carpenter	...	...	...	15	0	0
Side slopes $\frac{1}{2}$: 1 laid with forms						
1 : 1 laid without forms						
Earth tamped up to forms before concrete laid						
Height of slope 8 feet						
Concrete used 1 : 3 : 5 surface left rough and plastered						
with 1 : 3 mortar.						
Expansion joints left every 50 feet thus						
			<i>With Forms</i>		<i>Without Forms.</i>	
			Square feet		Square feet.	
Quantities laid	...	...	203,835		129,324	
			Rs.		Rs.	
Total cost	...	...	1,00,950		39,435	
Rates per 100 square feet—						
Engineering supervision	...	...	1.89		1.8	
Forms labour and material...	...	...	8.25		.9	
Concrete material and mixing	...	...	20.61		19.8	
Concrete placing and finishing	...	...	6.45		3.9	
Total	...	...	37.20		26.4	
Back filling and Trimming	...	...	12.30		5.1	
			49.5		31.5	Rs. per 100 square feet.
			148.5		94.5	Rs. per 100 cubic feet.

Notes—(1) Materials used in concrete cost Rs. 39-5-0 per 100 cubic feet concrete.

(2) Rates were an average 10 per cent higher owing to night work being done.

APPENDIX D.

Analysis of rate of Rs. 20 per hundred for lining.

Assumed to be of Kankar lining concrete 6" thick.

Mortar.		In concrete locally on Sirhind Canal.		
		Rs.	A.	P.
50 c.ft. Kankar lime at Rs. 38 % c.ft.	...	= 16	8	0
33.3 c.ft. Surkhi at Rs. 18 % c.ft.	...	= 6	0	0
16.6 c.ft. white lime at Rs. 50 % c.ft.	...	= 8	5	4
1 maund of white lime at Re. 1, maund, giving 2 c.ft. of slaked lime per maund.				
Water, work charged establishment, etc.	...	1	2	8
Cost of mortar per % c.ft.	...	32	0	0

Normal concrete

		Rs.
112.5 c.ft. Ballast at Rs. 10 %	...	= 11.25
40 c.ft. Mortar at Rs. 32 %	...	= 12.8
Labour at Rs. 5 %	...	= 5.0
		<hr/> 29.05
say	...	30

Concrete for lining.

		Rs.
Cost of normal concrete %	...	30.0
Add for small ballast Rs. 2 %	...	2.25
Add for 50 % of mortar	...	3.2
10 c.ft. at 32 %		
Add for extra labour in finishing surface and excavation of 50 c.ft. of earth per 100 s.ft. of concrete.		4.5
		<hr/> 39.95
say	...	40 % c.ft.

That is for 6" lining 20 % s.ft.

H. W. NICHOLSON, B.Sc., A.M.I.C.E.,
Executive Engineer, Project Division, Sirhind Canal.

APPENDIX E.

Correspondence on the subject of occupiers' rates.

No. 215-R.L., dated Lahore, the 8th March 1918.
 From—The Chief Engineer, Irrigation Works, Punjab.
 To—The Superintending Engineer, Sirhind Canal Circle

I HAVE the honour to forward 2 copies each of the letters noted in the margin for guidance in the preparation of Financial statements, etc., of the Bhakra Project (1 copy of each is for the Executive Engineer, Project Division), and to add that it would make these Financial statements far too complicated and lengthy if Financial Commissioners' figures are rigidly adhered to for each tract and that it will probably suffice for present purposes if suitable all round averages are struck and calculations thus reduced to reasonable limits.

1. Irrigation Branch letter No. 0115-R.L., dated 27th July 1917, and enclosures.
2. Senior Secretary to Financial Commissioners' Punjab, letter No. 251-554-1, dated 19th December 1917, and enclosures.
3. Irrigation Branch letter No. 127-R.L., dated 6th February 1918, and enclosures.
4. Senior Secretary to Financial Commissioners' Punjab, letter No. 251-554-2, dated 22nd February 1918.

No. 0115-R.L., dated 27th July 1917.
 From—The Chief Engineer, Irrigation Works, Punjab.
 To—The Senior Secretary to the Financial Commissioners, Punjab.

I HAVE the honour to send a map showing in colour wash areas the irrigation of which is being considered in the Bhakra Dam Project and to enquire what rates should be adopted in the preliminary project in our financial returns.

2. It will be seen that the areas are adjacent to the Sirhind and Western Jumna Canals and it is probable that ultimately the schedule of rates of the canal from which each area is served will be applied to that area, if it is not decided to adopt one uniform schedule for the whole series of channels served by the both canals.

For present purposes, however, we are chiefly concerned with what all round rates for receipts direct and indirect may be adopted for project purposes.

3. The average receipts on the Sirhind and Western Jumna Canals per acre assessed for past 3 years are as under : —

				Occupiers' rate.	Other direct receipts.	Total direct receipts.	Indirect receipts.
SIRHIND CANAL.							
1913-14	...	...	...	4.04	.34	4.38	.04
1914-15	...	...	...	3.60	.38	4.27	.03
1915-16	...	...	...	4.10	.37	4.47	.10
WESTERN JUMNA CANAL.							
1913-14	...	...	...	4.01 (4.69)	.10	4.23 (4.88)	.31
1914-15	...	...	...	3.47 (4.86)	.10	3.93 (4.55)	.28
1915-16	..	...	...	3.79 (4.48)	.18	3.97 (4.66)	.31

The figures in brackets show what the average occupiers' rate would have been if the present schedule of rates had been in force during these 3 years and the calculations are given in statements attached to this letter.

The crops likely to be grown on the new areas will probably approximate on the whole nearer to those on the Sirhind than on the Western Jumna Canal and the chief kharif crops will probably be jowar, bajra, moth, til, gawara and melons, and the chief rabi crops wheat, barley and gram.

In these circumstances I do not think we can safely accept a higher average rate for direct receipts than 4 or at outside 4.2.

As to indirect receipts the present land revenue rates are believed to be nominal and the project might be given credit for not less than Rs. 1-4-0 on all new irrigation.

APPENDIX E.

4. It may be explained that a connecting channel will be made from Patiala to Mandi on the Sirsa Branch, which below that point will become part of the Sirhind Canal and that the areas marked on plans A, B, C, J, K, T, R, U, N, O, F, G also will be served from it and possibly other unlettered but coloured areas further south.

But the Tosham, Bari Bhalaut and Rohana area, and possibly the Jund area near Bhiwani railway station will be irrigated by the Western Jumna Canal system.

5. The area F₁ now irrigated by the Grey Canals must also be considered; it will perhaps be thought right to follow the same rates here as recently accepted for the Sutlej Valley Project.

6. Like area F₁, areas F₂ and G. will only receive kharif irrigation and rabi first waterings, and for these 2 areas I would be glad to know what figures you would advise for adoption for (a) direct and (b) indirect receipts. All other new areas will receive perennial irrigation.

7. The cultivation on the Rangoi tract is highly precarious according to Mr. Townsend's settlement report and assured perennial irrigation should be welcome and there seems no good reason why the same rate 4 or even 4.2 discussed in paragraph 3 should not be adopted here for direct receipts, and 1/4 for indirect receipts, but from this should be deducted the value of the annual irrigation of the past few years at about Re. 0-12-0 per acre.

Similar treatment might be accorded to the area now served by the Northern Ghaggar Canal to which it is proposed to give perennial irrigation under the Bhakra project, but in this case the project apparently can take credit for full indirect receipts only for the new area.

8. How far we are justified in the special circumstances of this project, when the water will be brought to the land, with great difficulty and expense in putting the rate high, is a matter for consideration. The preparation of important projects is much simplified if undue weight has not to be given to extreme economy of design, while the brighter the financial prospects the more readily is sanction accorded. For these reasons, remembering that the extension of irrigation to new areas brings many indirect benefits in its train, we should not be too conservative in our estimates of probable returns. In the past such estimates have been handsomely exceeded.

APPENDIX E.

126

1913-14.

Class.	Nature of crops.	Area assessed.	Rate.	Amount assessed.	Remarks.
		Acres.	Rs. A. P.	Rs. A. P.	
I	Sugarcane	75,501	10 0 0	7,55,010 0 0	
II	Rice and water-nuts	10,264	6 8 0	97,584 0 0	
III	Orchards, gardens, tobacco, poppy, drugs, vegetables, spices, melons	18,188	5 8 0	1,00,034 0 0	
III-A	Wheat	199,443	5 0 0	9,97,215 0 0	
IV	Cotton, fibres, dyes, oil-seeds and all rabi crops except wheat, gram, masur, senji, maina and turnips	328,198	4 0 0	13,12,792 0 0	
V	All kharif crops not otherwise specified	63,972	3 0 0	1,91,916 0 0	
VI	Gram, masur, senji, turnips, carrots and maina	68,116	2 8 0	1,70,290 0 0	
VII	Crops grown on the 'wadh' of a previous crop. Single watering before ploughing not followed by a canal irrigated crop in the same or next harvest	4,081	1 4 0	5,101 0 0	
	Total	773,763	...	30,29,942 0 0	or 4.69 per acre assessed.

Class.	Nature of crops.	Area assessed.	Rate.	Amount assessed.	REMARKS.
		Acre.	Rs. A. P.	Rs. A. P.	
I	Sugarcane	65,879	10 0 0	6,58,790 0 0	
II	Rice and water-nuts	17,757	6 8 0	1,15,421 0 0	
III	Orchards, gardens, tobacco, poppy, drugs, vegetables, spices, melons	17,618	5 8 0	96,899 0 0	
III-A	Wheat	192,975	5 0 0	9,64,875 0 0	
IV	Cotton, fibres, dyes, oil-seeds and all rabi crops except wheat, gram, masur, senji, maina and turnips	356,192	4 0 0	14,24,768 0 0	
V	All kharif crops not otherwise specified	81,532	3 0 0	2,44,596 0 0	
VI	Gram, masur, senji, turnips, carrots and maina	98,345	2 8 0	2,45,803 0 0	
VII	Crops grown on the 'wadh' of a previous crop. Single watering before ploughing not followed by a canal irrigated crop in the same or next harvest	40,187	1 4 0	50,234 0 0	
	Total	870,485	...	38,01,446 0 0	or 4.36 per acre assessed.

APPENDIX E.

128

1915-16.

Class.	Nature of crops.	Area assessed	Rate.	Amount assessed.	Remarks.
		Acres.	Rs. A. P.	Rs. A. P.	
I	Sugarcane	39,392	10 0 0	5,98,920 0 0	
II	Rice and water-nuts	22,455	6 8 0	1,45,958 0 0	
III	Orchards, gardens, tobacco, poppy, drugs, vegetables, spices, melons	20,498	5 8 0	1,12,738 0 0	
III-A	Wheat	234,453	5 0 0	11,72,265 0 0	
IV	Cotton, fibres, dyes, oil-seeds and all rabi crops except wheat, gram, masur, senji, maina and turnips	237,283	4 0 0	9,49,132 0 0	
V	All kharif crops not otherwise specified	146,131	3 0 0	4,38,393 0 0	
VI	Gram, masur, senji, turnips, carrots and maina	75,698	2 8 0	1,89,216 0 0	
VII	Crops grown on the 'wadhi' of a previous crop. Single watering before ploughing not followed by a canal irrigated crop in the same or next harvest	10,359	1 4 0	12,949 0 0	
	Total	806,269	...	36,14,601 0 0	or 4.48 per acre assessed.

APPENDIX E.

No. 251-554-I, dated 19th December 1917.

From—The Senior Secretary to the Financial Commissioners, Punjab,

To—The Chief Engineer, Irrigation Works, Punjab.

IN reply to your letter No. 0115-R. I., dated 27th July 1917, I am directed to forward a copy of the Financial Commissioner's note, dated 24th November 1917, on the Bhakra Dam Project.

2. A copy of the statement showing certain particulars of the areas proposed to be irrigated from the Bhakra Dam referred to in the note accompanies.

Note, dated 24th November 1917, by the Financial Commissioner, Punjab, on the Bhakra Dam Project.

1. The case is not an easy one to deal with owing mainly to the wide dispersion and the very varying character of the numerous tracts or blocks to be dealt with. Their identification with the different assessment circles of the districts and states in which they are included has also been a matter of very considerable difficulty, more especially in the case of the Rohtak district, where there has been a post-settlement disruption of circles owing to the abolition of the Sampla tahsil. The identification has been carried out as far as possible in columns 1—3 of the attached statement. The other columns are self-explanatory. I propose to deal with each block as far as possible *sciatim*.

2. As regards direct (occupiers' rates) receipts, I propose to base my estimates on the figures furnished in paragraph 3 of the Chief Engineer's letter; modifying them where necessary with reference to general consideration of soil, climate, the present state of agriculture, etc. For the indirect receipts what is required is an estimate, based on the somewhat meagre data available, of the probable difference which after the introduction of canal irrigation will emerge between the net rental per acre of irrigated and unirrigated land and of the proportion of this difference which it will in practice be possible to take as a canal advantage land revenue in the shape of a fluctuating rate on area sown, or less probably in the form of a fixed nahri parta. In estimating indirect receipts I shall give weight to the consideration that though land at present uncultivated is generally in the tracts concerned capable of precarious barani cultivation without canal irrigation, nevertheless it will be the introduction of the latter which will in fact induce the bringing of such land under the plough. No estimates that it is possible to frame at this stage can of course claim anything approaching mathematical accuracy. In the case of the Native States concerned no question of indirect credit can arise.

3. As regards the districts at present served by the Western Jumna Canal, Karnal, Rohtak and Hissar, it is to be borne in mind that the only land revenue assessment of the nature of canal or water advantage which is at present levied is a light nahri-parta, which is scarcely a "wet" assessment at all, and that the difference between nahri and barani rentals is in fact not assessed to land revenue. For an explanation of this state of things reference may be made to—

Final Settlement Report of Rohtak, paragraph 33.

" " " of Karnal, paragraphs 46 and 47.

" " " of Hissar, paragraph 20.

The existing nahri-parta imposed on the above districts on canal-irrigated land is thus no sort of indication of possible future indirect receipts from the Bhakra Dam Project.

4. Block No. 1 comprises unirrigated portions of the Rohtak and Jhajjar tahsils there being adjacent Western Jumna Canal irrigation on the north and east. The chief canal-irrigated crops will no doubt be cotton and wheat with a good deal of cane as in the former Nahri II circle of Sampla. The crop area statistics of that circle give an all round average incidence of Rs. 5.3 per acre irrigated for the present occupiers' rates and indicate

APPENDIX E.

that Rs. 4.5 per acre irrigated is probably a fairly safe estimate of total direct receipts, the present Western Jumna Canal rates being adopted for the purpose. As regards indirect receipts it appears from paragraph 38 of the Rohtak Final Settlement Report that a canal water-advantage rate of from Re. 1 to Re. 1-8-0 per acre irrigated would have been considered suitable for the more Northern Gohana tahsil. For the old Sampla tahsil, in which a part of this block was included, the statistics available in the Assessment Report prepared in 1908 point to a figure lying between Re. 1 and Re. 1-12-0 per acre irrigated. Rupees 1.25 per acre will, I think, be a perfectly safe figure to take as an estimate for indirect (canal advantage) receipts.

5. Block No. 2 includes portions of the Bhawani and Hansi tahsils of Hissar and a small area in the Gohana tahsil of Rohtak. Judging from the available statistics of the adjacent Nahri assessment circle of the Hansi tahsil the chief canal-irrigated crop will be cotton with some wheat and gram. Rupees 4.2 per acre irrigated is a fairly full estimate of direct receipts based on the present Western Jumna Canal occupiers' rates. From column 11 of Statement XIV attached to the Hansi-Hissar Assessment Report prepared in 1909 the difference between nahri and barani cash rentals in the Hansi Nahri circle was Rs. 2 per acre. This indicates a canal advantage rate of Re. 1 per acre irrigated as a full estimate of indirect receipts. Possibly Re. 0.75 per acre would be safer.

6. It appears that Block No. 3, which is marked U on the map, includes portions of the Hissar and Hansi tahsils and that it will under the contemplated scheme receive perennial irrigation from the extended Sirhind Canal system. Having regard to the situation of the tract it is probably best to base the estimate of direct receipts on the present Western Jumna Canal rates given in the statements appended to the Chief Engineer's letter. The crop statistics of the Hissar Nahri circle given in paragraph 23 of the last Assessment Report indicate that the chief irrigated crops will probably be cotton in the kharif with a smaller proportion of wheat and some gram in the rabi. Rupees 4 per acre irrigated may be taken as a fairly full estimate of direct receipts in this block, while Re. 1 per acre will be a fair estimate for indirect receipts.

7. Block No. 4, marked R on the map, is the upper portion of the Fatehabad tahsil of the Hissar district and is to receive perennial irrigation from the extended Sirhind system but for the purposes of the estimate I propose to use the present Western Jumna Canal rates. From the statistics given in the Fatehabad Assessment Report it appears that in the adjacent Nahri circle of that tahsil the chief canal irrigated crops are cotton and gram and some wheat. The block includes a good deal of hard clay soil in the Naili assessment circle, where under perennial irrigation the chief crops will probably be rice and gram, while in the remainder the irrigated cropping will probably be much the same as in the Nahri circle. Rupees 3.75 per acre irrigated may, I think, be taken as a fairly safe estimate of direct receipts for this block from which, however must be made the deduction mentioned in paragraph 7 of the Chief Engineer's letter. Rupee 1 per acre may be adopted for indirect receipts as in Block No. 3.

8. This block lies south and south-east of Sirsa town and comprises at present unirrigated tract in the Hissar, Fatehabad and Sirsa tahsils. The western portion of it includes a large part of the sandy Bagar circles of those tahsils. With perennial irrigation the chief nahri crops will probably be cotton and gram with a certain amount of wheat. Rupees 3.3 per acre irrigated is probably a full estimate of direct receipts at present Western Jumna Canal rates for this block and similarly Re. 1 for indirect receipts.

9. This block lies in the south-western corner of the Sirsa tahsil and is included in the Naili assessment circle. It will appear possibly receive non-perennial irrigation from the Sirsa Branch of the extended Sirhind system. Much of the soil is high lying and sandy. Probably Rs. 2.25 and Re. .75 per acre irrigated may be taken as fair estimates for direct and indirect receipts, respectively.

10. These three blocks may conveniently be dealt with together. They are marked as T, K, J & A on the map, and forming a continuous tract include the whole of the Rohi and much of the Naili assessment circles of the Sirsa tahsil. It is proposed to give them perennial irrigation from the Sirhind system. I shall base my estimate of direct receipts on the present Sirhind Canal rates. The soil of the Rohi is generally a light loam, while in the Naili there is clay in the old bed of the Ghaggar and sandy soil elsewhere. Irrigated cropping in the Sirsa Rohi will probably follow the present lines of that of the Fazilka Rohi, which is extensively served by the Sirhind Canal; the main staples being wheat and gram, each covering about one-third of the total annual canal irrigated mature area, and the balance consisting mostly of inferior kharif crops. For total direct receipts Rs. 3.75 per acre irrigated will, I think, be a full estimate of total direct receipts for the combined area included in the three blocks under consideration. In comparison with the above it may be noted that the average all round incidence of Sirhind Canal occupiers' rates assessed in the adjoining Fazilka Rohi Circle during the quinquennium 1908-09 to 1912-13 was Rs. 3.4-1 per acre (Fazilka Assessment Report, paragraph 57). As regards indirect receipts it may be observed that the fixed nahri-parta recently imposed in the Fazilka Rohi was only 2 annas per acre. The reasons for so low a rate will be found in the Assessment Report and in the Reviews and orders thereon. The light rate in no way represents the full difference between nahri and barani rentals. From the statistics given in paragraph 46 and statement XV, column 20, of the Fazilka Assessment Report the difference would appear to be not far if at all less than Rs. 2 per acre irrigated. This points to a canal advantage rate of Re. 1 per acre on the whole. Rupee .75 per acre irrigated may be taken as a fair, possibly lenient, estimate of future indirect receipts from perennial Sirhind irrigation in the Sirsa Rohi; and this figure may accordingly be adopted for blocks 7, 8 and 9.

11. Block No. 10, marked O on the map, occupies the central portion of the Kaithal tahsil of the Karnal district and includes portions of four assessment circles, Nardak, Bangar, Bangar Pehowa and Naili. It appears to be partly irrigated at present from the Western Jumna and Sarusti Canals. It is proposed to give it perennial irrigation as now from the Sirsa Branch of the former. The chief irrigated staples in the Nardak and Bangar circles are in the former cane, cotton, rice and wheat, and in the latter cotton, wheat and gram. The average incidence of the present Western Jumna Canal occupiers' rates in the two circles appears to be about Rs. 1.7 and Rs. 4 per acre irrigated respectively. In the Bangar Pehowa and Naili circles canal irrigation is confined to the Sarusti, the main staples being rice and gram. The application of the present Western Jumna Canal rates to this irrigation would estimate yield all round incidences of about Rs. 3.5 and Rs. 4.5 per acre matured in the two circles, respectively, the proportion of rice in the Naili being high. On the basis of the above figures Rs. 4.5 per acre irrigated is probably not too high an estimate of total direct receipts from the new irrigation contemplated in Block No. 10. As regards indirect receipts the difference between average nahri and barani rentals per acre irrigated in the Kaithal, Nardak and Bangar circles appear from the figures given in paragraphs 17 and 18 of the last Assessment Report to have been in 1908 approximately as follows:—

	By <i>batai</i> rents.			By <i>cash</i> rents.		
	Rs.	A.	P.	Rs.	A.	P.
Nardak	1	14	0	1	2	2
Bangar	1	12	5	1	12	2

APPENDIX E.

From paragraph 23 of the same report it appears that Mr. Stow considered that Re. 1-8-0 and Re. 1-6-0 per acre would have been suitable rates for a fixed canal advantage in the irrigated portions of the Nardak and Bangar circles, respectively. These figures fully justify an estimate of Re. 1-3, and possibly Re. 1-4 per acre irrigated for indirect (canal advantage) receipts on the new irrigation contemplated in Block No. 10 in connection with the Bhakra Dam Scheme.

12. This block includes the area marked M and N on the map.

Block No. 11.

Patiala Kaithal Tract, north of Sarusti.

They include portion of the Naili, Andarwar and Powadh Circles of the Kaithal tahsil. Apparently there is at present some small amount of irrigation from the Sarusti Canal while it is proposed to give a perennial supply from the Sirsa Branch. The tract under consideration is not a prosperous one and accordingly I would not put the estimates at higher than Rs. 4 per acre irrigated for direct and Re. 1 for indirect receipts.

13. Block No. 12, marked F on the map, comprises the area now

Block No. 12.

Grey Canal Tract, north of Sutlej Navigation Channel and unirrigated tract south of Sutlej Navigation Channel.

irrigated by the Grey (Inundation) Canals in the Zirā, Moga and Ferozepore tahsils of the Ferozepore district. It is apparently contemplated that it will receive non-perennial irrigation from the modified Sirhind Canal system. I agree with the Chief Engineer (paragraph 5 of his letter) that the estimated rates accepted recently for the Sutlej Valley Project (paragraph 8 of my note, dated 3rd July 1917) may be adopted in this case also; that is direct receipts Re. 1-25 per acre irrigated and indirect Re. 75. The first of these two rates is decidedly lenient but there are special circumstances to be considered.

14. This block appears to comprise two detached pieces, one marked

Block No. 13.

Muktsar-Hithar.

G in the northern portion of the Muktsar tahsil of Ferozepore and the other (unlettered) in the Ferozepore tahsil. In both there is at present a little irrigation from the Grey Canal system. From paragraph 6 of the Chief Engineer's letter it appears that it is proposed to give non-perennial irrigation from the modified Sirhind system. The same rates may therefore be assessed as in the case of Block No. 12, that is Re. 1-25 per acre irrigated direct and Re. 75 indirect.

15. The block lettered E on the map includes the Utar and Rohi Assess-

Block No. E.

Existing Abohar Branch Tract.

ment Circles of the Muktsar and Fazilka tahsils of the Ferozepore district. Except for the Utar of Fazilka the tract is already fully irrigated perennially by the existing Sirhind Canal system. It is not mentioned in the Chief Engineer's letter, so that apparently no proposals regarding it are required.

16. The various blocks shown in the map as included in Native States

Blocks included in Native States.

Bikaner, west of Ghaggar.

Bikaner to be irrigated from Rohri Chautala (A-9) Distributaries.

Bikaner, south of Ghaggar, non perennial.

Bikaner included in tract south-west of Sirsa-Rewari Railway.

Dadri Tract in Jind.

Patiala.

Patiala-Kaithal Tract.

Tohana Branch Irrigation.

Uchana Tract.

Dudal Tract.

irrigated; while that suggested in paragraph 8 for Block No. 5 will possible

may be dealt with together. The block lettered C lies in Bikaner and for it perennial irrigation from the Sirhind system is proposed. Reference is invited to paragraph 11 of my note, dated 3rd July 1917, already quoted, regarding the forecast rates for the Sutlej Valley Project. For Block C Rs. 3-75 per acre irrigated may be taken as a fair, perhaps full, estimate of direct receipts. For the Block lettered B (also in Bikaner) the same rate of 3-75 per acre irrigated proposed in paragraph 10 above for Blocks Nos. 7, 8 and 9 in adjoining British territory may be adopted. For the Block of non-perennial irrigation proposed for Bikaner to the west and south of the Sirsa tahsil the same rate may be adopted for direct receipts as has been proposed for Block No. 6 in paragraph 9, that is Rs. 2-25 per acre

APPENDIX E.

suit the perennial irrigation which it is proposed to introduce into the tract of Bikaner territory which lies to the south of the above block. For the small area of Jind, south-west of Bhiwani, for which the perennial irrigation from the Western Jumna Canal may be possible, Rs. 4 per acre irrigated is probably a full estimate of direct receipts. For the small area of Patiala territory coloured with yellow marks in the map direct receipts may, I think, be estimated at not less than Rs. 4.25 per acre irrigated.

17. The estimates proposed in above paragraphs are collected in the statement below :—

Statement showing direct revenue per acre for kharif channels on the average of 3 years 1914-15 to 1916-17 in the Ludhiana Division, Sirhind Canal.

Name of Distributary.	KHARIF.					RABI.				
	Total sum assessed for Kharif.	Area irrigated.	Area assessed.	REVENUE PER ACRE.		Total sum assessed for Rabi.	Area irrigated.	Area assessed.	REVENUE PER ACRE.	
				On area irrigated.	On area assessed.				On area irrigated.	On area assessed.
	Rs.	Acres.	Acres.			Rs.	Acres.	Acres.		
Khanpur ...	15,033	2,657	2,649	5.66	5.67	3,642	2,047	2,044	1.78	1.78
Jassowal ...	6,776	1,454	1,453	4.66	4.66	1,711	1,103	1,102	1.55	1.55
Akalgarh ...	2,286	491	487	4.65	4.69	600	377	377	1.59	1.59
Chupki ...	330	58	58	5.69	5.69	35	20	20	1.75	1.75
Pakhowal ...	10,717	2,156	2,144	4.97	4.84	2,415	1,552	1,549	1.56	1.56
Talwandi ...	8,498	1,973	1,900	4.31	4.33	2,641	1,639	1,637	1.61	1.61
Pohir ...	535	143	143	4.44	4.44	106	70	70	1.52	1.52
Dahlon ...	6,322	1,262	1,255	5.00	5.03	1,207	795	795	1.51	1.51
TOTAL ...	51,776	10,471	10,425	...	...	12,646	7,768	7,759	...	...
Average of all channels				4.87	4.99				1.62	1.63
Average for the year on area irrigated									$\frac{51,776-12,646}{10,471-7,768}$	= 3.53
" " " " assessed									$\frac{51,776-12,646}{10,425-7,759}$	= 3.54

No. 127-R. I., dated 6th February 1918.

From—The Chief Engineer, Irrigation Works, Punjab,

To—The Senior Secretary to the Financial Commissioners, Punjab.

With reference to your letter No. 251-554-1, dated 19th December 1917, forwarding a copy of Financial Commissioner's note, dated 24th November 1917, on the Bhakra Dam Project, I have the honour to suggest that paragraph 14 of that note requires reconsideration.

There are 2 tracts; the first F₂ comprising both part of Faridkot State and the area north of it coloured red and extending roughly to the Sutlej Navigation Channel, all bounded by green line; the second tract is G, south of Faridkot.

There is in reality no irrigation in the areas for which Financial Commissioner is now asked to fix rates. The map, which is only a rough indication of localities, may have been misleading in this respect, as it included Ferozepore Station round which, I believe, there is some irrigation from the Grey Inundation Canals. But for the present purposes we want rates for the areas outside the tract now touched by the Grey Canal system, i.e., for blocks F₂ and G.

These tracts will be served by kharif channels leading direct from the present Sirhind Canal system and there seems no reason why we should not adopt the same occupiers' rates as now in force on that canal.

APPENDIX E.

For the purely kharif distributaries on that canal I find that, as per detailed statement below, the average direct receipts are 4.87 and 1.62 per acre irrigated in kharif and rabi, respectively, the rabi rates representing 1st waterings and the average rate for both crops is 3.53 per acre.

I suggest, therefore, that for financial forecasts we assume 3.5 per acre irrigated for direct receipts instead of 1.25.

2. In Financial Commissioner's note, paragraph 2, it is said that in the case of Native States no question of indirect credits can arise. This is of course true in the sense it was written, but for project purposes, though the Indian Government will not receive these indirect credits, it is necessary to estimate them so that the project as a whole can be examined with reference to its financial advantages to each of the parties, Supreme Government and Native States, who will be interested in it.

For all the Native States concerned, Bikaner, Jind, Patiala and Faridkot (omitted from the summary of Financial Commissioner's proposals) it is suggested that in preparing the financial returns, which must go with the project, 1.25 per acre irrigated be adopted.

Summary of proposals.

Number of Block.	Letter if any in map.	District or States in which included.	Nature of irrigation proposed.	ESTIMATED FUTURE RECEIPTS PER ACRE IRRIGATED.		
				Direct.	Indirect.	Total.

British territory.

				Rs.	P.	P.
Block 1	...	...	Rohtak	...	Perennial	...
Block 2	...	...	Hissar and Rohtak	...	Perennial	...
Block 3	...	U	Hissar	...	Perennial	...
Block 4	...	R	Hissar	...	Perennial	...
Block 5	...	...	Hissar	...	Perennial	...
Block 6	...	...	Hissar	...	Non-perennial	...
Block 7	...	T	Hissar	...	...	...
Block 8	...	R	Sirsa	...	Perennial	...
Block 9	...	J				
Block 10	...	O	Karnal	...	Perennial	...
Block 11	...	M & N	Karnal	...	Perennial	...
Block 12	...	F	Ferozepore	...	Non-perennial	...
Block 13	...	I				
Block 13	...	G	Ferozepore	...	Non-perennial	...
...	...	E	Ferozepore	...	...	...

Native States.

...	C	Bikaner	...	Perennial	...	...
...	B	Bikaner	...	...	...	...
...	...	Bikaner	...	Non-perennial	...	...
...	...	Jind	...	Perennial	...	...
...	...	Patiala	...	Perennial	...	...

APPENDIX E.

No. 251—554-2, dated 22nd February 1918.

From—The Senior Secretary to the Financial Commissioners, Punjab,
To—The Chief Engineer, Irrigation Works, Punjab.

In reply to your letter No. 127-R. I., dated 5th February 1918, regarding the Bhakra Dam Project, I am directed to say that Rs. 3.5 per acre irrigated for direct receipts seems to the Financial Commissioner to be too high as compared with the figure of Re 1.25 for Block F shown in the map referred to in your letter above mentioned. Mr. Fagan would prefer not to go higher than Rs. 2.5 per acre for Block No. 13 (F₂ and G.).

2. As regards indirect credit in the territory of the Native States referred to in paragraph 2 of your letter, I am to say that the Financial Commissioner has no data immediately available for an estimate of indirect receipts in these States, but he agrees that Rs. 1.25 per acre irrigated is not an excessive figure to adopt for each receipt.

**Statement showing the area irrigated on the Sirhind Canal,
British Branches.**

Average of 3 years, 1911-14.

District.	Tahsil.	Kharif.	Rabi.	Total.	Per cent.
Ludhiana ...	Ludhiana ...	12,976	20,352	33,328	3.4
	Jagraon ...	12,216	24,736	36,952	3.8
	Total ...	25,192	45,088	70,280	7.2
Ferozepore ...	Ferozepore ...	263	464	726	.1
	Moga ...	47,654	95,140	142,794	14.7
	Muktsar ...	49,018	101,988	154,006	15.9
	Fazilka ...	102,555	217,578	320,128	32.9
	Total ...	199,489	418,165	617,654	63.6
Hissar ...	Sirsa ...	3,430	5,407	8,837	.9
Grand Total British Territory		228,111	468,660	696,771	71.7
Patiala ...	...	31,486	71,505	103,991	10.9
Nabha ...	...	16,124	32,451	48,575	5.0
Jind ...	...	924	1,912	2,836	.3
Faridkot ...	...	36,314	77,759	114,073	11.7
Kalsia ...	...	1,201	2,417	3,618	.4
Total States		89,019	186,101	275,153	28.3
GRAND TOTAL		317,160	654,761	971,924	100.0

APPENDIX E.

No. 26 (R & A—Irrgn), dated Lahore, the 27th March 1905.

From—A. H. DIACK, D.-q, Chief Secretary to Government, Punjab and its Dependencies,
To—The Senior Secretary to the Financial Commissioner, Punjab.

I AM directed to forward, for the information of the Financial Commissioner, a copy of the correspondence noted in the margin regarding the revised schedules of occupiers' rates on lands irrigated by the British branches of the Sirhind Canal, with the request that the instructions contained in paragraph 7 of Punjab Government No. 44, dated the 22nd April 1901, may now be considered cancelled and that the orders contained in paragraph 6 of the Government of India letter No. 1717-C.W.-1., dated the 1st December 1904, may be noted.

1 Government of India, Revenue and Agricultural Department letter No 260 SO-I., dated the 12th February 1898, to the Government of Burma

2. Punjab Government Irrigation Department, letter No 025 R. I., dated the 18th June 1901, to Government of India, Public Works Department.

3 Government of India, Public Works Department, No 1717 C.W.-1., dated the 1st December 1904, to Punjab Government, Irrigation Department

4. Punjab Government, Irrigation Department, endorsement No. 14-R. I., dated the 12th January 1905.

2. I am also to ask that the attention of the Commissioner of Jullundur, may be drawn to the remarks in paragraph 4 of the letter just mentioned regarding aid to District Boards.

No. 27 (R. & A.—Irrgn.).

COPY of the foregoing and its enclosures, and of Punjab Government letter No. 44, dated the 22nd April 1901, forwarded to the Political Agent, Phulkian States and Bahawalpur, for information, with reference to his letter No. 3652, dated the 27th October 1903, and for communication to the Patiala Darbar of the purport of the orders now passed by the Government of India on the whole case.

No. 28

COPY of the foregoing forwarded to the Secretary to Government, Punjab, Public Works Department, Irrigation Works, for information.

No 265 SO-I., dated Calcutta, the 12th February 1898.

From—J. B. FULTON, Esq., C.I.E. I.C.S., Offg Secretary to the Government of India, Revenue and Agricultural Department,

To—The Revenue Secretary to the Government of Burma.

A LARGE and costly perennial canal is now in process of construction in the Mandalay District of Upper Burma, and proposals are under consideration for other similar works in the Shwebo and Minbu Districts. The existing irrigation systems of Upper Burma are understood to be confined to small works, many of them of private construction; and the method and rates of assessment by which revenue and water-rates have hitherto been levied upon irrigated land will in all probability be found unsuitable to the case of a great State work, such as will now shortly be opened for the first time in the province. The Government of India think, therefore, that it will be advisable to consider beforehand what changes in the existing system will be necessary, and what rates it will be desirable to impose, so that when irrigation is begun there may be no hesitation or uncertainty. And it is in order to ask His Honour the Lieutenant-Governor to take the matter into consideration, and to make, for the approval of the Supreme Government, definite and detailed proposals with regard to the Mandalay canal, which will be the first to be completed, that I am now directed to address you.

2. Mr. Bayne's letter No. 32-2-S.-12, dated 2nd May 1893, to the address of my predecessor, gave cover to a note on the subject of water-rate assessment in Upper Burma, which was written by Sir Frederic Fryer as Officiating Chief Commissioner. In that note he pointed out that the existing water-rates were provisional only, and were in all probability too low; and that as soon as fuller information regarding the cost and value of irrigation was available, it would be necessary to reconsider, and probably to raise, them. He explained that the tenancy tenure, was so rare in Upper Burma that there was but little danger of the landlord absorbing an undue share of the value of the water in the form of rent, and thus making it difficult or impossible for the State to raise its charge for water to the cultivator who uses it. And he strongly combated the view which had been expounded by Mr. Smeaton as

Financial Commissioner that the State must limit its charges to the cost to itself at which it supplied the water. Sir Frederic Fryer was of opinion that "a fair commercial value should be put upon all water supplied, provided that the price charged was not so high as to bar its use upon lands which really derived benefit from canal irrigation". He thought that the security against drought which irrigation afforded was so strong an inducement to the use of the water that it was unnecessary to leave to the cultivator a large margin of profit from its use, and that probably about one-fourth of the difference in value of the produce on dry and on irrigated land, respectively, would be sufficient, the other three-quarters of the increased value being retained by the State. He was of opinion that water-rates should be differentiated according to the amount of water supplied, the crop for which it was used and the cost of applying it to that crop. He explained that, while he had concurred, as a provisional measure, in Mr. Smeaton's proposal to fix for the present the water-rate at one-fourth of the increase in gross produce due to irrigation, this proportion might well be exceeded, since there was no reason, save that of policy, why the State should not exact the whole of the additional produce due to irrigation from the water which it supplies, and certainly no reason why the rate should be restricted to any maximum below what the Government might fairly demand and the cultivator could pay without difficulty. He pointed out that there was as a rule only one class to be dealt with, namely, the actual occupiers, and not the two classes of owners and occupiers as in the North-Western Provinces. And he concluded with the following remarks:—

"In the interests of the province I think that the profits of State-constructed irrigation works should not be swallowed up by the irrigators. Irrigation is very much needed in Upper Burma, and those who have it already, or are about to get it, should pay such an amount as they can afford to pay for it in order that the benefits which they receive may be extended to others, which is not likely to be the case unless irrigation works in Upper Burma can be shown to be remunerative on the whole."

3. The general principles thus enunciated by His Honour have the most cordial concurrence of the Government of India. They afford the only basis for irrigation charges which is not unjust to the tax-paying community at whose expense canals are constructed. Certain considerations to which reference will presently be made render moderation essential in fixing water-rates upon Government canals. But postulating that moderation, Government is not justified in selling its water for less than it is worth; since if it charges a cultivator Rs. 3 only for what is worth Rs. 5 to him—not what has cost Government Rs. 5, but of which Rs. 5 is the normal selling value in the open market—it presents him with Rs. 2 as certainly as if it had paid him that amount in cash; and in the case under consideration the Rs. 2 will come out of the pocket of the general public in whose behalf we administer India. Subject, then, to what Sir Frederic Fryer alluded to as considerations of policy, the rates should be pitched as high as may be possible without discouraging resort to irrigation. Unfortunately, in Upper India, where an enormous amount of capital has been sunk by the State in the construction of canals similar to those which are now being or about to be made in Upper Burma, the principles set forth above were, in the early years of what was then a new experiment in India, overlooked or neglected, with the result that the annual income derived by Government from these canals is far smaller than it should be, and that although the mistakes made are now clearly recognised, it is almost impossible to rectify them.

4. The Government of India are anxious that advantage should be taken of the experience gained at so great a cost, in order to avoid similar errors in introducing what is a new experiment in Upper Burma, and they have therefore directed me to set forth in outline, for the Lieutenant-Governor's consideration, the lesson that has been learned and the conclusions to which it has led. They fully recognise that the conditions of Burma are very different from those of India—more different, probably, than anyone who has not served in the province can realise—and that it is dangerous to argue from the one to the other. But they believe that the general principles involved will be identical in both cases, or at any rate that principles which have been applied with great success in the case of recent canals in Upper India should be before His Honour when he is framing the scheme for his province.

5. It will in the first place be well to indicate the exact nature of the two sets of rates which are, perhaps somewhat inconveniently, known in Upper

APPENDIX E.

India as owner's and occupier's rates, respectively; as from the manner in which the subject has been dealt with in the "Directions to Settlement Officers in Upper Burma" it would appear that the fundamental distinction between them has perhaps not been quite clearly apprehended.

6. If Government brings water to a man's door, and he makes use of it to irrigate his field, it is entitled to charge for it, just as a private company in England charges for gas or water laid on to and used in a house. Subject to certain considerations which will presently be discussed, and which make for moderation in the charge, the matter is one of supply and demand to be dealt with on commercial principles, and the charge for water is the price of goods sold. The rates thus charged for the water have been called occupier's rates because they are paid by the man who is in occupation of the land and buys and uses the water, whether he also owns the land or not. They are of course charged only when the water is supplied by Government.

Quite apart from this commercial transaction, the State is entitled to take as land revenue a share of the produce (which it generally limits to a share of the profits) of all land, by whomsoever it may be owned, and to whatsoever factors the produce or profits may be due. Consequently, it is entitled to a share of that increase in the produce or profits of land which is due to the fact of its being irrigated; and this, whether the water for irrigation is supplied by Government or by another. In practice the demand on account of land revenue is ordinarily limited to a share of the proprietary profits; so that when that portion of it which is due to irrigation is taken in the form of rates, those rates are called owner's rates, and are recovered from the owner, whether he occupies the land or not, since in the latter case they are the Government share of the additional rent which the fact of his land being irrigated enables him to secure. But the owner and the occupier may be the same person, in which case he pays both rates.

A third case is the tenant or "occupant" of State land under a raiyatwari tenure, such as all State land in Upper Burma is held upon. Here he is the "occupier" for the purpose of the occupier's rates; and if he is assessed, as it is proposed he should be in Upper Burma, to a rent or revenue which is very considerably below the economic rent, he is also the "owner" for the purpose of the owner's rates, since a very considerable proportion of the proprietary profits is left in his hands, and when those profits are increased by irrigation, the value of the share of them which Government retains to itself should increase correspondingly.

7. The Upper Burma Land and Revenue Regulation distinguished these three cases most clearly. The tenant or "occupier" of State land was to pay rent [section 25(b)]. The owner of private land was to pay land revenue (section 27). All land irrigated from Government works (and no other land) was to pay water-rates (section 34). These last were clearly meant to be occupier's rates pure and simple, charged for the use of the water supplied by Government; and it was intended that the Government share of the additional produce due to the use of water, whether supplied by Government or not, should be recovered as part of the rent or revenue, quite apart from the water-rates. The rules under the regulations provided that the rent on State land should be the value of the customary share of the average annual gross produce of the holding (rule 25), which would, of course, include a share of any increase in produce due to irrigation. The basis of the assessment of private land to land revenue was left to be settled by executive directions; and water-rates were not dealt with at all.

8. When the "Directions to Settlement Officers" which, it may be noted, were intended to be entirely tentative, came to be framed, it would appear that the distinction between owner's and occupier's rates, or at any rate the fact that the water-rates were intended to be purely occupier's and not owner's rates, was not clearly borne in mind. The directions began with a provision which has been found in the North-Western Provinces, in the Punjab and in Burma* alike to be unworkable in practice by directing (paragraph 56) that the rent on State land and the revenue on private land should be based upon the net produce of the land as it would be if the crops were *unaided by artificial*

* See paragraph 4 of Mr. Gait's letter No. 4814-2-8.—7, dated 21st May 1896.

APPENDIX E.

irrigation, or what used to be called in Northern India "in its dry aspects," thus excluding the Government share of the increase in produce due to the irrigation. They then fixed (paragraph 59) the water-rates at a share of the *increase of produce due to irrigation*; and they explained (paragraph 60) that land irrigated from private sources was not to pay water-rates because the increased produce was due to the cultivator's expenditure, and was therefore a *permanent improvement not liable to be taxed*. This last remark indicates that it was as land revenue (or owner's rates) that the water-rates were considered; and the limits fixed in terms of the produce and the whole course of the discussion seem to show that it was mainly in this light that they were regarded. The addition made by the Government of India to paragraph 59 of the directions was intended to secure that Government should not take (in the form of water-rates) a smaller proportion of the produce due to irrigation than it took (in the form of land revenue) of the produce independent of irrigation. But the fact was apparently overlooked that Government is entitled to this share of the produce as land revenue, quite independently of, and in addition to, the value of the water which it supplies, and indeed whether the water is supplied by it or not. It is true that some of the subsequent directions are properly applicable to occupier's rather than to owner's rates; and that one-fourth of the gross increase may in some cases exceed half the net increase due to irrigation, in which case the excess would constitute a charge for the use of water. It is true, also, that the method prescribed was to be applied to small works only, upon which it is often convenient not to distinguish between owner's and occupier's rates, but to make one consolidated charge only. But, broadly speaking, it seems to be the case that what were originally intended to be occupier's rates pure and simple, were turned into what are mainly, if not wholly, owner's rates, and that, as the directions stand, no occupier's rates can be levied in Upper Burma, while land irrigated from private sources is assessed as unirrigated; so that, if the system were to be applied generally, Government would abandon, not only the whole value of its water as a commodity, but also the whole of the land revenue to which it is entitled as its share of the increase in produce due to irrigation from private sources.

9. I am first to point out that the permanent exemption from assessment to land revenue of produce due to private irrigation, which is effected by paragraph 60 of the directions, conflicts with the principle which was affirmed after full discussion with the Secretary of State, and which is embodied in the proviso to section 11 of the Land Improvement Loans Act (XIX of 1883) and in section 22 (b) of the Burma Rules under that Act.

The Government of India are strongly in favour of the most liberal treatment of improvements due to the expenditure of private capital. Terms should be fixed (if this has not been done already) during which such improvements should be wholly exempt from assessment; and care should be taken that they are sufficiently long to allow of the capital expended being fully recouped. But when the terms thus fixed have expired, the land becomes liable to assessment upon its value as it stands, and the rent or revenue should be adapted to the productiveness of the soil, as is the universal practice throughout Northern India. So soon as occupier's rates are restored to their proper place in the system, the matter will right itself. But meanwhile, the Government of India think that paragraph 60 of the directions is misleading, and I am to ask that, unless there is some reason to the contrary which has not suggested itself to them, the second sentence may be cancelled on the first convenient opportunity, liberal provision being at the same time made for the exemption of permanent improvements from assessment for a reasonable term of years.

10. But, as His Honour pointed out in 1893, the future extension of State irrigation in Upper Burma depends upon the adequacy of the return upon the capital expended; and that can never be secured, in the case of a large irrigation work, so long as Government contents itself with the culliance-ment of the land revenue which will result from the increase in net-asset due to irrigation, an enhancement to which it would be equally entitled if the irrigation were provided from resources other than those of the State. The main basis of the financial scheme of a large perennial canal is the scale of occupier's rates; and the pitch at which they are to be fixed is a matter of the

APPENDIX E.

greatest importance. The whole tendency of recent years has been to levy full occupier's rates, so as to reduce to the lowest possible point the margin left available to the landlord from which to increase his rent; and on the latest large canal the occupier's rates are pitched so high that for the present no owner's rates are taken. The matter is discussed in Mr. Muir-Mackenzie's letter of 9th September 1892, to the Government of the North-Western Provinces, of which a copy has already been communicated to you with this department's letter No. 670, dated 22nd March 1893. Neglect of this principle (a neglect which was natural enough while all were feeling their way in the matter) has led to the annual loss to the State of an enormous revenue in the North-Western Provinces, which can probably now never be wholly recovered; for when any considerable portion of the value of Government water has once been annexed by the landlord in the shape of rent, in the first place Government can claim half only, and not the whole of it, as land revenue, and, in the second place it is very difficult to secure even that half without running the risk of the landlord's making the tenant pay it over again, more especially if it is taken in the form of rates. Moreover, when once the rents have been raised, it is almost impossible to force them down again by raising the occupier's rates without incurring, at any rate in theory, the risk of ruining a whole generation of tenants in the process. And this is particularly the case when rent is taken (as is understood to be often the case in Upper Burma) in the form of a share of the produce; for then the rent rises automatically with the larger yield due to irrigation. This last consideration is doubtless of greater weight in the North-Western Provinces, where tenancy holdings are the rule, than in Upper Burma, where they are believed to be the exception; though the facts can hardly be said to be yet known with accuracy, as it is understood that detailed statistics are as yet limited to districts in which most of the land is held by cultivators direct from the State. In the other districts private land has been estimated by the Government of Burma to constitute about four-fifths of the whole cultivated area, and there seems some reason to believe that a substantial proportion of it is in the hands of tenants. Nor is this all. Even if the landlord may be said at present not to exist in Upper Burma, it is certain that a system of unduly low charges for water would tend to create him. As has been already pointed out in Sir Edward Buck's letter No. 1768 of 21st July 1893, in which he conveyed the orders of the Government of India upon Sir Frederic Fryer's note already referred to, just as by limiting its revenue demand to a portion only of the profits of the land, the British Government has, in so many parts of India, made a rent-receiving landlord possible for the first time, so also by limiting its charge for water to a portion of its value it will afford an opening to the middleman. Any margin of profit will attract him, whether it accrues on the land or on the water.

11. On the other hand, it is often necessary to begin with low occupier's rates when a large irrigation work is first opened, in order to induce the people to take the water. This may not be so necessary in a rice-producing country like Upper Burma, where the people must be fully alive to the value of a command of water, and where irrigation was very generally practised before the troublous times that preceded annexation. But in any case, if low initial rates are thought advisable, the Government of India are of opinion that it should be distinctly understood that they are provisional only; and they would suggest that perhaps the simplest and best way of making this point clear beyond a doubt is to fix full rates at once, and if leniency is desirable in the first instance, to remit a proportion of them for the first few years. And, however full the rates may appear to be when first fixed, all experience shows that it is essential that they should be subjected to periodical reconsideration (not necessarily alteration), so as to keep them fairly near to the full value of the water. The conditions upon which that value depends change, often rapidly, especially when irrigation is still in course of being established; our knowledge of them increases in fullness and accuracy; and the Government of India are of opinion that occupier's rates should be examined quinquennially, with reference to their sufficiency or otherwise.

12. If this examination is properly made, there would appear to be no need to lay down any standard for their assessment. The general basis is

APPENDIX E.

that they should be as high as the cultivator can afford to pay with ease. The rates current in Northern India will afford some rough guide to start with; and if at any time the rates are raised too high, the contraction of irrigation will at once give notice of the fact. They should probably be fixed separately for flow and lift irrigation, and for the various main classes of crops. I am to enclose a copy of a note by Colonel Ottley, R.E., lately Inspector-General of Irrigation, which shows the various scales of occupier's rates at present in force upon the perennial canals of the Punjab. It will be seen that the rates, which are in most cases in addition to an assessment of land revenue upon the irrigated value of the land, are enormously in excess of the water-rates at present charged in Upper Burma, which have so far, however, been applied to small works only.

13. Another strong reason for maintaining the pitch of occupier's rates is to be found in the fact that, on the inferior soils for which manure cannot be spared, constant irrigation does positive harm, and that one way of preventing it being applied to them is to so adjust the charge for water that they will not pay for irrigation, thus confining its use to the soils where it will be most valuable. And yet another reason is that whenever, as in the case of irrigation by flow, water in unlimited quantity can be obtained by a stroke of the spade, there is a strong tendency to use it with reckless profusion over almost the whole cultivated area, with, in the end, results of the most disastrous nature to the cultivation. So far as experience in Upper India has shown, there are only two ways of preventing this indiscriminate use of canal water. One is to limit the supply; but it is difficult to do this safely when rice is the crop to be irrigated. The other is to raise the charge for water so as to limit the area which it pays the cultivator to irrigate.

14. Probably the considerations discussed in the preceding paragraph possess less force in Burma than in Northern India. It is understood that in Lower Burma more than 90 per cent. of the whole cultivated area is under rice; and that even in Upper Burma the area is very large, and used to be abundantly irrigated by works which fell into disrepair under Thebaw's rule. Under such conditions it is possible that men and soil alike are proof against the effects of inundation. But in Upper Burma there are also large tracts of high land on which crops other than rice are grown; it is almost certain that the irrigation from large perennial canals will be extended to them also; and for this reason it will perhaps be useful to bear these considerations in mind.

15. In the preceding paragraphs of this letter allusion has been made to the necessity for moderation in fixing occupier's rates. The considerations which impose that necessity upon Government are not so weighty in the case of a new canal, as in the case of old-established irrigation which has moulded itself upon existing conditions, any sudden or violent alteration in which must disturb the whole economy of local agriculture. But even in the case of a new canal, moderation is advisable; and stress has been laid upon the vital importance of so fixing the occupier's rates that they shall represent something like the real value of the water, not because it is desired unduly to reduce the margin of profit from irrigation which must be left to the cultivator, but because all past experience shows that the tendency in fixing the scale of these rates is to pitch them at a wholly inadequate level. Nothing, however, is further from the wish of the Government of India than to go to the other extreme. In the case of canals such as those under consideration, Government possesses a monopoly of the water supply, and it would be unwise to take advantage of its position to charge purely competitive prices. The rates should be so fixed as to allow a reasonable margin of profit from the use of water upon all land to which a supply can be given and which is fitted to bear irrigation without injury. The amount of profit to be derived from its use will vary with the nature of the soil and crop, with the method of cultivation and with a hundred small variations of conditions. It is a question which I am to commend to His Honour's consideration, whether that absolute uniformity of rates throughout the whole of the enormous area commanded by a large canal, which has grown up till it has become a tradition in Upper India, is necessary or advisable; and whether, when the value of water varies greatly (as it often does) in different parts of that area, it might not be well to make a correspond-

APPENDIX E.

ing variation in the charges for its use. But whatever may be done in that direction, it is impossible so to vary the rates for water as to cover all the multifarious conditions upon which its value depends; and since the rate for each class must be such as to leave a reasonable profit upon the least productive land and crop to which it is desired that water should be applied, the profit left in the case of the more productive must often be large.

16. This being so, it remains, after the occupier's rates have been fixed, to consider how best to secure, in the shape of land revenue, the Government share of the considerable margin of proprietary profit which, however high those rates may be pitched, must necessarily be left in the hands either of the cultivator or of his landlord. And this is done by assessing irrigated land to a higher revenue than dry land. Fortunately, the system of land revenue assessment which is in force in Upper Burma cuts the knot of the two most difficult questions which have arisen in India in connection with this assessment. In the first place, there is no room for discussion as to whether the land revenue due to irrigation should be taken in the form of a rate or of a lump assessment. In Upper Burma all assessments of land revenue are in the form of rates, which are levied only when the land is cultivated; and the Government of India have recently taken occasion to urge strongly their opinion that this system should be continued, at any rate for the present. It is true that a permanent supply of canal water will do much to cure the uncertainty of outturn which is one of the main reasons for the retention of the system. But even if the ordinary land revenue assessment in Upper Burma were fixed for a term for each holding, it would seem that, for the present at least, whatever is taken from the people on account of irrigation from a Government canal should be taken in the form of rates, to be paid only when they have actually made use of the water. When irrigation from a canal has firmly established itself under settled conditions and has approached its natural limits of extension, it is possible to mark off the areas which may be treated as canal-irrigated, and to ascertain the proportion of each which, on the average of a term of years, annually receives water. And these data being given, it is possible, and indeed often advisable, to impose upon the whole of the area a moderate enhancement of land revenue which is fixed for the terms of settlement. But in the case of a new canal from which irrigation is in process of development the data necessary for this purpose do not exist; while it is essential, not only to encourage the spread of irrigation, but also to leave the irrigator the utmost freedom in the matter till experience has taught him the conditions most favourable to his interests. And this can be done only by giving him the assurance that whatever he pays on account of irrigation, he pays only when and so long as he actually takes water, and for the land to which he actually applies it; and that he can at any moment relieve himself from all liability by ceasing to irrigate.

It may then be asked, why have two sets of rates, one representing the charge for water, and the other the land revenue due to irrigation? In the first place, the former will vary with the nature of the crop, while the latter will depend upon the quality of the soil, and will thus cure to some extent the inequalities of the former which have just been referred to. In the second place, the former will be paid by the cultivator and the latter by the owner, wherever these are separate persons. In the third place, the former will be levied on such land only as is irrigated with Government water, while the latter will be levied on all irrigated land. And in the fourth place, the latter will in all probability be pitched lower on private than on State land, while the former will be the same for both. Of course in practice there would not be three rates on irrigated land, but simply the occupier's rate and an enhanced land revenue rate, no separate owner's rate being framed, but the portion of the land revenue which is fairly attributable to irrigation being made a book-credit to the canal. The first of the above considerations does not apply when very large areas of practically uniform soil are placed year by year under the same crop, as may possibly be the case in some of the rice tracts of Burma. And were it possible to have the assurance that, at least in the great majority of cases, the owner and the cultivator

APPENDIX E.

are and will continue to be the same person, and that the occupier's rates have been so fixed as to leave only a comparatively small margin of profit from the use of water, it might perhaps be well, in the case of irrigation by means of water bought from Government, to leave the margin of proprietary profit untouched. But neither of these conditions can be assured, at any rate as a continuance; and since it may become at any moment necessary to impose an enhanced land revenue assessment on account of the profit from canal irrigation, it will perhaps be wise to do so from the first, in order to avoid a subsequent change of system, even though it may be decided that the additional assessment should be light.

The second point in which the revenue system of Upper Burma facilitates the dealing with the question of canal assessments is that the standard of assessment prescribed is a share of the net profits after deducting the cost of cultivation, which, in the case of irrigated land, will include the cost of irrigation. Thus, so far as this standard is followed, the assessment is self-adjusting, any increase in the charge for water involving a corresponding reduction (of half the amount) in the land revenue demand. It is true that this should involve a reconsideration of the land revenue rates whenever the occupier's rates are altered. But there can be little doubt that, for some time to come, the term of settlement in Upper Burma will seldom if ever exceed five years; and in that case the two sets of rates can always be considered together, though the argument tends to enforce the advisability (referred to in paragraph 11 above) of any initial leniency in the occupier's rates taking the form of a temporary remission on full rates; the land revenue rates being calculated on the full, and not on the reduced, rates if the term for which they are fixed exceeds the term for which the remission is granted. And apart from any question of short settlements, when once the occupier's rates have been raised to a pitch which fairly represents a moderately full value for the water, they will not be further raised except on the ground of an *increase in the value of the water* (due, for instance, to a rise in prices); and such an enhancement would be independent of the land revenue assessment, and would not render it necessary to revise it.

17. If, then, these principles are accepted as applicable to Upper Burma, it would appear that the first thing to be done is to cancel the instruction of paragraph 56 of the directions, which prescribes that land is to be assessed to land revenue "in its dry aspect". As Sir Frederic Fryer points out in Mr. Gate's letter No. 481-2-S.-7, dated 21st May 1896, it is practically impossible to say what land that has never been cropped without irrigation would yield if it were so treated. In many cases (especially in rice lands of old standing) it would probably yield nothing. And the principle of dry assessment which was introduced as a corollary to the owner's rate system, has now been abandoned as impracticable in both the North-Western Provinces and the Punjab, canal land being assessed at wet rates. If in any tract land which is irrigable from a canal is as a fact cultivated on occasion without irrigation, and if the net profits of such cultivation are materially smaller (as they almost certainly will be) than those of irrigated cultivation, it will be necessary to fix dry as well as wet revenue rates; for disastrous experience on the older canals has shown how pernicious it is to force the cultivator to irrigate his field year by year, however much it may need rest from water, by imposing a revenue demand which can be paid only by the help of irrigation. So again, in the case of land to which irrigation is now for the first time to be extended, separate dry and wet rates will be required. But in these cases the Settlement Officer will have the facts of dry cultivation before him on which to base his assessment. There is also another contingency, the possibility of which should perhaps be contemplated. It may be that, under favourable circumstances, the cost of irrigation from private works may be materially less than from a Government canal. In that event (the irrigation being supposed to be equally efficient in both cases) a higher land revenue demand will be justifiable in the former than in the latter case. The amount of the difference, and the area upon which it could be levied, will enable the local authorities to decide in each case whether the amount of revenue at stake is sufficient to justify a multiplication of rates.

18. Such are the principles which the Government of India would ask the Lieutenant-Governor to consider, and to frame at his leisure, after

APPENDIX E.

consultation with his officers, a scheme for the assessment of water and land revenue rates upon the perennial canals which they are about to construct in Upper Burma. The final result of past experience in Upper India is that the best system for a large perennial canal is that of occupier's rates varying with the crop grown, pitched as high as may be possible without discouraging resort to irrigation, and subject to quinquennial revision, supplemented by a somewhat higher assessment of land revenue upon wet than upon dry land. The Government of India, however, fully recognise that this system may need modification before it can be applied to the very special circumstances of Upper Burma. That is for His Honour to consider. But the Governor-General in Council has thought it well that he should know how much money has been lost and what difficulties have arisen in the North-Western Provinces and in a less degree in the Punjab; so that, as far as possible, their mistakes may not be repeated in Burma, but that advantage may be taken of their experience. No doubt useful hints might be obtained from the study of the canal systems of other parts of India also, and especially of Madras, where the conditions probably approximate in some respects to those obtaining in Upper Burma. Finally, I am to explain that what has been written above, applies only or mainly to large and costly irrigation works. In the case of small canals of old standing, such as are believed to be numerous in Upper Burma, everything depends on their nature, their history and the local customs and traditional method of management; and (as no one knows better than Sir Frederic Fryer) they must necessarily be administered with reference to the special conditions of each. And though the principles which underlie the foregoing remarks may doubtless be borne in mind with advantage in the case even of such canals, yet it is not for a moment suggested that the same uniformity of system should characterize their management as is possible and desirable in the case of the larger and more costly works.

Nos. 221 and 262-80-I.

Copy forwarded to the Public Works Department for information.
Financial

Endorsement by Government, Punjab, Public Works Department, Irrigation Branch.

No. 14-R. I., dated Lahore, the 12th January 1905.

Copy forwarded to A. H. Diack, Esquire, Chief Secretary to Government, Punjab, Civil Department, for

*Secretary to the Government of India, Public Works Department, Irrigation, Roads and Buildings, No. 1717-C. W.-I., dated Calcutta, the 1st December 1904, and enclosure.

information, in continuation of Chief Engineer's unofficial No. 1-R. I., dated 4th January 1905, and Chief

Secretary's unofficial, dated 5th January 1905, and with the remark that the Senior Secretary to the Financial Commissioner, Punjab, is also being furnished with a copy of the present communication.

2. Only one copy of Government of India, Revenue and Agricultural Department, No. 260-80-I., dated 12th February 1898, has been received, and this is submitted in original, with the request that this branch may be supplied with copies of the same when printed.

No. 025-R. I., dated Simla, the 16th June 1904.

From—J. BERTON, Esq., Secretary to Government, Punjab, Public Works Department, Irrigation Branch,

To—The Secretary to the Government of India, Public Works Department, Irrigation, Roads and Buildings.

I AM directed to forward, for sanction of the Government of India, a

Revenue and Agriculture Proceedings for March 1902.

Revenue and Agricultural Department, Nos. 9-19, December 1903.

Revenue and Agricultural Department, Nos. 4-23, April 1904.

Note on proposal to revise water-rates of British branches, Sirhind Canal, by Major Popham-Young.

Chief Secretary's No. 44, dated 22nd April 1904, to Senior Secretary to Financial Commissioner, Punjab.

draft notification (to be issued in conformity with the provisions of section 75 of Act VIII of 1873) of revised schedules of occupiers' rates on lands irrigated by the British branches of the Sirhind Canal, in supersession of those sanctioned in your No. 192-1., dated 30th October 1888, and with reference thereto to forward, for information, copies of the correspondence noted on the margin.

2. I am to point out that the proposal to enhance the occupiers' rates started with the question as to the method in which the increase of revenue due to irrigation from the Sirhind Canal should be levied in the Fazilka Tahsil of

the Ferozepore District, and that it was finally decided by the Lieutenant-Governor and approved by the Government of India that this increase should be levied in the form of an enhanced occupier's rate (*vide* letter No. 440, dated 10th March 1902, from Under-Secretary to the Government of India, Revenue and Agricultural Department, to Revenue and Financial Secretary to Government, Punjab). As the whole of the land lying in British territory and irrigated by the Sirhind Canal has hitherto been assessed in its unirrigated aspect only, it was decided to enhance the rates, not only for the Fazilka Tahsil, but for the whole area irrigated by the British branches of the Sirhind Canal, including Native States. I am to invite your attention to Chief Secretary to Government, Punjab's, letter No. 44, dated 22nd April 1904, to Senior Secretary to the Financial Commissioner, Punjab, from which it will be seen that as the occupiers' rates now proposed include a land revenue charge in addition to the charge for water, it will be necessary for the Punjab Government to claim from the Imperial Government its share of the portion of income from occupiers' rates which is properly land revenue and to allow to the Native States irrigating from the British branches of the Sirhind Canal a refund of such portion of the occupier's rate which is considered their right as representing land revenue.

The portion of the increased income due to the enhancement of occupiers' rates, which is to be regarded as the equivalent of wet land revenue assessment, has still to be decided.

3. The schedule of rates, which formed the basis of the discussion referred to in letter No. 44, dated 22nd April 1904, from Chief Secretary to Government, Punjab, to Senior Secretary to the Financial Commissioner, is that detailed in statement E of Chief Engineer's note, dated 2nd October 1903.

In accordance with the instructions conveyed in the last sentence of paragraph 4 of Chief Secretary's letter quoted above, the following changes in this schedule were agreed to by Financial Commissioner and Chief Engineer and approved by the Local Government :—

(a) To raise the rates for all crops of class II to Rs. 5-4-0 and Rs. 5 for flow irrigation in zones I and II, respectively.

(b) To include gram and masur in class IV, raising the rates on these crops to Rs. 3-4-0 and Rs. 3 for flow irrigation in zones I and II, respectively.

(c) To include in class V "crops grown on the 'Wadh' of a previous crop" and to raise the rate to Re. 1-8-0 for flow irrigation.

(d) To raise the rate of class VI to Rs. 2-4-0 for flow irrigation.

Lift rates are in all cases to be half of flow rates.

The schedules of rates now forwarded have been framed in accordance with these proposals.

The lower schedule of rates for the Fazilka Tahsil has been proposed because it is generally conceded that the comparative poorness of soil and lowness of the half-net asset in that tahsil entitles it to a lower rate of assessment than the rest of the irrigated area.

4. The following table compares the assessments of the schedule of rates now in force with the various schedules of rates proposed by the officers mentioned. The figures are calculated on the average cropped area for five years ending 1900-01 as given in paragraph 64 of Settlement Officer's Sirsa-Fazilka Report, dated 24th May 1902, and refer only to British districts :—

Schedule.	Amount of assessment.
	Rs.
Schedule now in force	18,94,411
Proposed by Settlement Officer	28,53,942
Ditto, Settlement Commissioner	25,41,743
Ditto, Financial Commissioner	28,95,620
Ditto, Chief Engineer (originally)	21,97,443
Ditto, Financial Commissioner and Chief Engineer and agreed to by Local Government	22,54,544

The anticipated increase in assessments therefore amounts to Rs. 22,54,544—Rs. 18,64,411 = Rs. 3,60,133.

5. It is proposed to bring the new schedules of occupiers' rates in force from the rabi crop of 1904-05.

No. 1717-C. W.-I., dated Calcutta, the 1st December 1904.

From—SIDNEY PRESTON, Esq., C.I.E., Secretary to the Government of India, Public Works Department, Irrigation, Roads and Buildings,

To—The Secretary to Government, Punjab, Public Works Department, Irrigation Branch.

I AM directed to return, duly sanctioned by the Governor-General in Council, with slight verbal alterations, the draft notification of revised schedules of occupiers' rates on lands irrigated by the British branches of the Sirhind Canal, which were received with your letter No. 025-R. I., dated 18th June 1904, and in doing so am to communicate the following remarks.

2. The Government of India observe that the Punjab Government regards the enhancement of occupiers' rates proposed as partly representing a wet assessment of land revenue, and recommends that, as the revised rates "include a land revenue charge in addition to the charge for water" the Provincial Government should receive from the Imperial Government its share of the portion of the income from occupiers' rates which is properly land revenue, and that the Native States irrigating from the British branches of the canal should be allowed a refund of such portion of the occupiers' rate as is considered their right as representing land revenue. In pursuance of this view it is also proposed to give to the District Boards concerned "the percentage on the land revenue portion of the enhancement which they are entitled to claim as local rates". As the Government of India are unable to admit that any portion of the enhanced occupiers' rates can be considered to be of the nature of land revenue, I am to take this opportunity of explaining their views as to the character of an occupier's rate and the principles on which it should be calculated; and of enclosing, for the information of the Punjab Government, a copy of Mr. Fuller's letter No. 260-8C-1, dated 11th February 1898, to the Government of Burma, in which these principles were discussed in detail.

3. Briefly, the Government of India hold that when a canal has been constructed at the cost of the State, justice to the tax-paying community at whose expense it has been made requires that, subject to considerations of policy which render moderation essential, the rates to be charged for the use of the water should be pitched as high as may be possible without discouraging resort to irrigation, and that the irrigators from such a canal should pay for the water such an amount as they can afford to pay for it in order that the benefits which they receive may be extended to others. The introduction into a tract of irrigation at the expense of the State increases the produce of cultivation, and the Government, as representing the tax-payer, is entitled to a portion of that increase (1) as the owner of the water which it has brought to the fields at great cost and then sells to the cultivators, and (2) as the sovereign landlord, entitled as such to an enhancement of land revenue in proportion to the enhancement in the proprietary share of the produce. The fixing of the price for the water is of the nature of a commercial transaction, and should be regulated mainly by the price the cultivator is willing to pay for it. It is not, however, practicable to fix it so high that no profit is left to the cultivator, and there is thus a margin of profit, usually represented by a rise of rent, to a share of which the State is entitled as land revenue; and seeing that we are practically bound by our rules and declarations not to take as land revenue more than half the increase in the proprietary share of the produce, it follows that it is to the interest of Government to raise the occupiers' rates, which represent the price of the water, as high as can fairly be done consistently with due moderation and without curtailing the demand for the water. The two classes of charge therefore stand on different bases. The occupier's rate is a charge for the water and is levied from the occupier under the Canal Act, while the land revenue is a share of the proprietary profits and is levied from the landowner under the Land Revenue Act. There is also a further distinction between the two charges which must not be lost sight of, in that the payment

APPENDIX E.

of the occupier's rate is optional while payment, of the land revenue is compulsory.

4. In view of the opinion expressed in the previous paragraph, the Government of India are unable to agree that the enhanced occupiers' rates now sanctioned include any charge of the nature of land revenue, or that any claim to share in the enhancement can be admitted on that ground. They cannot therefore approve the proposal that Native States whose lands are irrigated from British branches of the canal should be allowed any share in the enhanced occupiers' rates by way of compensation for loss of land revenue. Apart from any special agreement that may have been made with a Native State on the subject, the Imperial Government is entitled to charge as occupiers' rates on such irrigation whatever price for the water it thinks fit, and those occupiers' rates are in no sense land revenue and must be credited to the Imperial treasury as canal income. For the same reason no claim can be admitted on behalf of District Boards to a share in the enhanced occupiers' rates to compensate them for a loss of local cesses; at the same time it is possible that as the introduction of irrigation leads to increased population, higher cultivation, greater traffic, more need for communications and larger demands upon the boards, while owing to the system on which local rates are assessed on land revenue only, their income does not increase in proportion, it may become necessary for the Provincial Government to make grants-in-aid to District Boards in canal-irrigated districts. Such grants the Local Government will now probably find itself able to make in consideration of the share of the enhanced occupiers' rates that it will receive under the recent financial settlement.

5. I am to express the approval of the Government of India of the change made under which the lift rates are fixed at only half those charged for flow irrigation, and of the principle now introduced for the first time of charging different rates in different zones with regard to the varying value of the water. I am also to invite special attention to paragraph 11 of the letter to the Government of Burma above quoted, and to suggest that in the case of a new canal, fairly full occupiers' rates should be announced in the first instance with liberal reductions for the first five or ten years so as to start irrigation and induce the people to take the water.

6. After full consideration of the statistics furnished in the reports attached to your letter under reply, the Government of India are of opinion that the occupiers' rates now sanctioned are distinctly moderate, and I am to request that they may be examined after five years so that after experience of their effect on the demand for water and on the rent rates it may be considered whether they should not be further enhanced.

Enclosure to letter No. 1717-C.W.-I. of 1904.

DRAFT NOTIFICATION.

PUBLIC WORKS DEPARTMENT.

IRRIGATION BRANCH.

Dated Calcutta, the June 1904.

No. R. I.—In exercise of the powers conferred by section 75 of the Northern India Canal and Drainage Act, 1873 (VIII of 1873), and with the previous sanction of the Governor-General in Council, the Lieutenant-Governor is pleased to prescribe the following schedules of occupiers' rates to be charged in respect of lands irrigated by the British branches of the Sirhind Canal, in supersession of so much of the first schedule published with notification No. 6616-I., dated 27th November 1888, as relates to that canal.

ZONE I.

Class.	Crops.	RATES PER ACRE.						RATES PER LOCAL UNIT.												Per						
		Flow.			Lift.			Kachā bigha.				Ghumao.				Pacca bigha.										
		Rs.	A.	P.	Rs.	A.	P.	Rs.	A.	P.	Rs.	A.	P.	Rs.	A.	P.	Rs.	A.	P.							
I	Sugarcane	12	0	0	6	0	0	2	8	0	1	4	0	10	0	0	5	0	0	7	8	0	3	12	0	Crop.
II	Rice, orchards, gardens, poppy, indigo dyes, drugs, spices, water-nuts, maize, wheat, vegetables (except turnips).	5	4	0	2	10	0	1	1	6	0	8	9	4	5	9	2	3	0	3	4	6	1	10	3	Orchards and gardens per half-year, the rest per crop.
III	Cotton, chillies, melons, tobacco, fibres, bailey, oil-seeds, berra, senji, all on-fodder crops in kharif and rabi not specified.	4	0	0	2	0	0	0	13	3	0	6	9	3	5	0	1	10	6	2	8	0	1	4	0	Crop.
IV	Bajra, jowar, chari, moth, mung, mash, guar, chana, masur, gram, turnips, peas and all kharif and rabi fodder crops not specified.	8	4	0	1	10	0	0	10	9	0	5	6	2	12	0	1	6	0	2	0	6	1	0	3	Crop.
V	Single watering before ploughing not followed by a crop. Also crops grown on the "Wadh" of a previous crop.	1	8	0	0	12	0	0	5	0	0	2	6	1	4	0	0	10	0	0	15	0	0	7	8	Each watering.
VI	Special rates which may be made applicable to channels selected by the Local Government. A single watering before ploughing followed by a rabi crop.	2	4	0	1	2	0	0	7	8	0	3	9	1	14	0	0	15	0	1	6	6	0	11	3	Crop.

ZONE II.

(All lands irrigated by the British Branches of the Sirhind Canal and the Fazilka Tahsil of the Ferozepore District.)

Class.	Crops.	RATES PER ACRE.		RATES PER LOCAL UNIT.				Per
		Flow.	Lift.	Pacca bigha.				
				Flow.		Lift.		
		Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.			
I	Sugarcane	10 0 0	5 0 0	6 4 0	3 2 0	Crop.		
II	Rice, orchards, gardens, poppy, indigo dyes, drugs, spices, water-nuts, maize, wheat, vegetable (except turnips).	5 0 0	2 8 0	3 2 0	1 9 0	Orchards and gardens per half-year, the rest per crop.		
III	Cotton, chillies, melons, tobacco, fibres, barley, oilseeds, berra, sonji, all non-fodder crops in kharif and rabi not specified.	3 12 0	1 14 0	2 5 6	1 2 9	Crop.		
IV	Bajra, jowar, chari, moth, mung, mash, guar, china, masur, gram, turnips, peas and all kharif and rabi fodder crops not specified.	3 0 0	1 8 0	1 14 0	0 15 0	Crop.		
V	Single watering before ploughing not followed by a crop.	1 8 0	0 12 0	0 15 0	0 7 6	{ Each watering. Crop.		
	Also crops grown on the "Wadh" of a previous crop.							

APPENDIX E.

ASSESSMENT OF CANAL-IRRIGATED LANDS IN THE RESETTLEMENT OF THE
LUDHIANA DISTRICT.

No. 180, dated Lahore, the 28rd March 1910.

From—E. R. ASBOTT, Esq., Senior Secretary to the Financial Commissioner, Punjab,

To—The Chief Secretary to Government, Punjab.

IN reply to your letter No. 213 (Revenue), dated 16th November 1903, I am directed to submit a copy of letter No. 70, dated 8th January 1910, with enclosures, from the Settlement Commissioner, Punjab.

2. In the past eight years the average irrigation in the Ludhiana District has been, in round figures, 52,000 acres, half in the Ludhiana, and half in the Jagraon Tahsil. The irrigation in the former may be divided again into 12,000 acres on kharif rajbahs and 14,000 on perennial channels. The perennial irrigation is in the Jangal Circle where there are no wells. Before 1901-02 all irrigation was perennial. The following figures are worth noting :—

Average irrigation.	On Rajbahs now kharif.	In Jangal Circle of Ludhiana.	In Jagraon.	TOTAL.
	Acres.	Acres.	Acres.	Acres.
Ten years ending 1900-01 ...	13,713	18,933	26,489	54,075
Eight years ending 1908-09 ...	12,290	14,035	26,047	52,372

It will be observed that, except in the part of the district in which kharif was substituted for perennial irrigation in 1901-02, the figures for the two periods are practically identical. Yearly details will be found in the statement appended to this letter.

3. It was stated in a note, written in 1903 by the present Inspector-General of Irrigation on the revision of the occupiers' rates on the Sirhind Canal, that "fairly good crops are got with a small amount of rain, while the people sow such crops as will come to maturity with little rainfall. There is no canal in the Punjab where the demand for canal water and the area irrigated fluctuate so much". Turning to the table appended to this letter, it will be seen that the fluctuations in the irrigated area were much more violent in the ten years ending 1900-01 than they have been since. Confining attention to the last eight years, we find irrigation on the kharif rajbahs has not varied in a remarkable degree. The extremes are 16 per cent above the normal in 1905-06 and 23 per cent. below it last year. There is no want of water in the river in the kharif, and the fluctuations must be due to the character of the rainfall. In the Jangal Circle of Ludhiana irrigation has been wonderfully steady. Once in 1905-06 it has risen 23 per cent. above, and once in 1908-09 it has fallen 33 per cent. below, the normal. Excluding these two years, the variations are unimportant. This is equally true of the irrigation in Jagraon. The cause of fluctuation in Ludhiana is mainly this, that in years of favourable rainfall the people can, and do, cut down their canal irrigation. In other words they are fortunate enough to be able to get good crops without paying for water.

4. The schedule of occupiers' rates on the Sirhind Canal was revised by notification No. 273-B., dated 21st December 1904. A small attempt at differentiation was made. Two zones were formed, but the difference in the rates adopted, except in the case of sugarcane, which is a crop of little importance on the canal as a whole, amounts only to 4 annas an acre. The Ludhiana District is in the higher assessed zone I. The incidence of occupiers' rates on the Sirhind and Bari Doab Canals and of occupiers' and owners' rates on the Western

APPENDIX E.

Jumna Canal for the triennium ending March 1908 (appendix 8 of Revenue Report of Irrigation Department) has been as follows :

Harvest.					Sirhind.	Western Jumna Canal.	Bari Doab Canal.
					Rs.	Rs.	Rs.
Kharif	...	..	...	...	3.6	3.9	3.2
Rabi	...	...	...	...	3.8	3.5	2.8

The Sirhind rates are a good deal higher than the Western Jumna Canal rates, but on the latter canal the general incidence is raised by the larger proportion of high-class crops. On the Sirhind wheat mixed with gram and gram are important canal crops. There is at present no nahri-parta on nahri land in the districts watered by the Sirhind Canal. In paragraph 6 of Government of India No. 1717-C.W-1., dated 1st December 1914, the opinion was expressed that the revised occupiers' rates on the Sirhind Canal were distinctly moderate, and re-examination after five years, with a view to determine the possibility of further enhancement, was ordered. The period has elapsed, but, with reference to the orders passed regarding the much lighter schedule for the Western Jumna Canal, the Financial Commissioner assumes that the existing schedule on the Sirhind Canal will for some time to come remain undisturbed, and that we may frame our assessment policy accordingly.

5. Fluctuations in the irrigated area on a canal may be due to—

- (a) differences of demand ; and
- (b) differences of supply.

As we have seen on the Sirhind Canal in Ludhiana, it is the former that has by far the greater influence. In a year of abundant rainfall, when canal water is taken for a much smaller area than usual, the revenue paying capacity of the people is increased, and not diminished. Fluctuations due to variations of supply in a tract dependent on irrigation are a good reason for a fluctuating canal land revenue. Where the variations depend on demand, the objections to fixity of demand are greatly weakened. When the owner's rate was introduced on the Western Jumna Canal 3 years ago, they were nevertheless felt to be very strong, but when the change from a fixed wet assessment to a fluctuating owner's rate was under discussion, the Western Jumna Canal tract was waterlogged, and the important matter seemed to be to frame our assessments in such a way as to induce people to take water only when they wanted it. On a scientifically-constructed canal with pretty high occupiers' rates and with kharif rajbahas, where only kharif irrigation seems necessary, the argument in favour of a fluctuating land revenue practically disappears. So long as the occupier's rate fluctuates and the present kharaba system survives, we may not do much to diminish corruption by making our revenue fixed, but we may pave the way to more fixity in the future. Mr. Douie therefore agrees that canal land in the Ludhiana District should bear a fixed nahri assessment. As Mr. Dunnett says that nahri rents are paid on the nahri land, whether it is actually irrigated or not, the nahri rate should be applied to the recorded area.

6. On the Western Jumna Canal the difference between the barani and nahri rates has ranged from 14 to 56 per cent. In the older and richer irrigated tracts on that canal it has varied a good deal, but the average excess of the nahri rate in them may be taken as 25 per cent. Till the barani and nahri rents in Ludhiana have been examined in detail and compared with the existing and revenue dry rate it is futile to discuss whether the nahri rate should be a full dry rate or a light wet rate. The impossibility of taking anything like a standard assessment may decide the case in favour of the former.

7. Mr. Dunnett looks to a fixed canal assessment as a means of differentiating between good and bad estates. He says that in the Jangal Circle "adjoining villages differ sometimes as the poles". For the reason given by Mr. Douie in paragraph 12 of letter No. 4641, dated 18th October 1906, on

APPENDIX E.

differentiation of occupiers' rates on the Lower Chenab Canal, submitted to Government with my letter No. 343, dated 5th July 1909, the Financial Commissioner doubts whether it will be possible to make the balance even between good and bad estates by action confined to the land revenue head. He would therefore allow the Settlement Officer to propose, where necessary, the application of the zone II schedule of occupiers' rates to any estates requiring special leniency. The total number of such estates would probably be small. The differentiation which the existing schedules permit is not so wide as Mr. Douie could wish. The true remedy for corruption in connection with the assessment of occupiers' rates is, in Mr. Douie's opinion, the abolition of "holding to holding" kharaba and liberal differentiation of occupiers' rates. But that seems hardly at present within sight. Meanwhile we might experiment as to the possibility of a contract system. It should be open to Mr. Dunnett to suggest its adoption for a short period experimentally in a limited area.

8. It may be hoped that remodelling in Ludhiana is now complete. Of course no further changes should take place without the Deputy Commissioner being consulted. That is already provided for, but Mr. Douie understands that the difficulty often is that the Deputy Commissioner cannot give any confident opinion on the details of a remodelling scheme. It should be definitely laid down that if any change is in future made in existing outlets, the effect on the irrigation of the estate affected shall be the subject of a special enquiry by the revenue staff not later than two years after the change takes place, and it should then be decided—

(a) whether any reduction of the nahri assessment is required ; and

(b) whether any new distribution of the revenue over holdings is necessary.

Rules can be drafted, as Mr. Diack suggests, by the Settlement Officer.

9. It is unlikely that in Ludhiana it will be necessary to make any provision for assessment of future extensions of irrigation. It seems improbable that any will take place.

APPENDIX.

YEAR.	LUDHIANA.		LUDHIANA.		JAGRAON.	
	Rainfall : June— September.	Nahri area, kharif branches.	Rainfall of year.	Nahri area, Jangul Circle.	Rainfall of year.	Nahri area.
1891-92,	12.55	6,138	16.18	14,865	19.10	19,544
1892-93	33.59	7,990	43.59	5,695	28.70	1,272
1893-94	22.33	9,878	27.17	6,383	33.42	15,858
1894-95	30.27	7,956	38.55	7,234	43.12	13,481
1895-96	17.91	14,625	19.70	16,129	17.24	15,272
1896-97	13.33	23,674	17.2	19,722	12.07	46,945
1897-98	17.43	7,97	21.72	18,558	17.67	33,860
1898-99	18.26	17,434	20.66	16,741	20.64	33,465
1899-00	8.87	25,402	13.05	18,756	13.49	48,774
19 0-01	38.68	16,739	47.89	15,646	38.30	26,904
Average 10 years	21.26	18,713	26.57	13,923	24.37	26,499
1901-02	20.39	17,843	23.16	12,654	19.87	33,135
1902-03	18.34	10,254	22.49	14,818	18.6	27,782
1903-04	16.78	9,779	23.11	14,076	18.19	26,298
1904-05	9.18	11,018	17.15	14,335	24.24	25,713
1905-06	10.98	17,890	18.71	17,306	15.68	27,583
19 6-07	16.42	11,534	23.53	15,470	31.30	24,853
19 7-08	22.69	10,854	27.86	14,215	25.99	23,632
1908-09	28.01	9,161	27.80	9,414	26.89	19,129
Average 8 years	17.24	12,290	23.75	14,085	22.70	26,047

No 70, dated Lahore, the 6th January 1910.

From—A. H. DIACK, Esq., Settlement Commissioner, Punjab,

To—The Senior Secretary to the Financial Commissioner, Punjab.

PARAGRAPH 6 of your letter No. 414-S., dated 14th September 1908, to the Punjab Government, gave expression to the opinion of Sir James Wilson that in the Ludhiana District the fixed assessment of canal-irrigated land should be only the amount which it could fairly be called on to pay if unirrigated, and that the excess over such assessment of the total amount which might be claimed as the Government share of the landowners' assets should be added to the occupiers' rates, which should be enhanced in proportion. In paragraph 4 of their letter No. 1496-451-2 in the Revenue and Agricultural Department, dated 5th November 1908, the Government of India referred to the above opinion, and asked to be informed of the decision of the Punjab Government in the matter of the assessment of canal-irrigated lands. The Punjab Government accordingly, in their letter No. 213, dated 16th November 1908, directed a report on the subject to be submitted by the end of the current cold weather. Subsequently, in their letter No. 259, dated 19th November 1909, they requested that it might be expedited, in view of the decision of the Government of India to postpone the settlement of the Amritsar District till after the determination of the system of canal assessment to be adopted in Ludhiana. These orders were communicated to me in your letters Nos. 5850 and 5900, dated 24th and 25th November 1909, and I have now the honour to submit the required report, which is contained in letter No. S59, dated 29th December 1909, from the Settlement Officer of Ludhiana.

2. As was observed in the Punjab Government letter last quoted the decision arrived at in regard to the assessment of land irrigated by the Western Jumna Canal must be taken as indicating the lines on which the assessment proposals for the Sirhind Canal should be framed. In fact, that decision must govern the principles of canal assessment in the Ludhiana District unless the case for a fluctuating wet assessment of canal-irrigated land is stronger there than in the Delhi Division. It will be seen from Mr. Dunnett's letter that that is not so. The principal argument in favour of a fluctuating wet assessment on the Western Jumna Canal was that owing to the radical reconstruction which the canal system had undergone in the last 20 years, the supply of water to villages and holdings had varied considerably from year to year, and that similar variations are likely to occur in the future because the development of the canal is not yet complete. The Sirhind Canal has undergone no such radical alteration, and although in the Ludhiana District outlets have recently been remodelled, something like finality appears now to have been reached in that respect, and the result of the remodelling has been, in the opinion of the Settlement Officer, to increase the stability of irrigation and to ensure to the villages and holdings now receiving water the same supply for the future that they receive at present. The restriction of irrigation to the kharif harvest in half the area irrigated by the canal has been in operation for eight years, and though felt as a hardship at first, is now acquiesced in. It would not in any case furnish an argument for a fluctuating assessment.

3. The Settlement Officer also shows that even before remodelling the supply of canal water was fairly regular, and that the area of crops matured with the aid of canal irrigation has varied much less from year to year than the area under barani crops, which will certainly be placed under a fixed assessment. Sir James Wilson's opinion, to which reference was made at the commencement of this letter, was based on the assumption that "canal-irrigation in this district fluctuates greatly from year to year". The statistics now furnished show that in normal years the fluctuations are not great, and that such fluctuations as do occur are due to the people contracting their demand for canal water in years of abundant rainfall and raising it in years of drought, and it seems clear that in such years of drought the canal has been able fully to meet the demand made upon it in Ludhiana.

4. I think it is probable therefore that even if a different decision had been arrived at in respect of the Western Jumna Canal, the Settlement Officer and myself would have recommended for the Sirhind Canal in Ludhiana the

APPENDIX E.

maintenance of the present scale of occupiers' rates and the imposition of a fixed assessment on canal-irrigated land which should be sufficiently high to take some account of the profits derived by landowners from canal irrigation, and should consequently exceed by a material amount the assessment of unirrigated land. And I should personally have been influenced in making this recommendation by the fact (referred to in the second sentence of paragraph 7 of my letter No. 35-S., dated 12th August 1908, submitting the Ludhiana forecast) that the present schedule of canal rates was introduced only in 1905, and that it would not be desirable to enhance them further so soon.

5. If a fixed wet assessment is decided on for the Ludhiana District, it will be necessary, as pointed out in paragraph 10 of Mr. Dunnett's letter, to make provision for the contingency which, as has been observed, he considers improbable, of further remodelling of outlets being undertaken in the future. It must, I think, be a corollary of a fixed wet assessment that no such remodelling shall be undertaken until the concurrence of the local revenue officers has been obtained. When remodelling has been carried out with such concurrence, a redistribution of the *nahri parta* can, as Mr. Dunnett suggests, be carried out. But it will be necessary to provide for the remission of the *nahri-parta* while the remodelling is in progress, and the Settlement Officer might be instructed to frame rules with that object and submit them for approval in his Ludhiana or Jagraon Assessment Report, whichever is first submitted.

6. For the reasons given above and in Mr. Dunnett's letter, I recommend for adoption in the Ludhiana District the system of assessment sketched in his 11th paragraph.

No 889, dated Ludhiana, the 29th December 1909.

From—J. M. DUNNETT, Esq., I.C.S., Settlement Officer, Ludhiana,

To—The Settlement Commissioner, Punjab.

I HAVE the honour to reply to your endorsement No. 4146, dated 30th November 1909, calling for early submission of a report on the proposed method of assessing canal-irrigated lands in this district.

2. The orders of the Government of India on the subject of the assessment of canal-irrigated lands in the Delhi Division are so explicit on the question of principle that a detailed report is probably not required. I append to this report only statements showing the rainfall (Nos. I and I-a) and the fluctuations in *nahri* cropped areas (No. II). These, with the further information I have to give, will show that the principles laid down by the Government of India and acquiesced in by the Punjab Government can in practice be applied successfully to this district.

3. When the district was last assessed, no land received irrigation from canals, though the construction of the Sirhind Canal had been practically completed. Irrigation began shortly after settlement. *Nahri* land therefore pays only a fixed revenue assessment calculated on its unirrigated aspect and occupiers' rates, which do not include any charge in the nature of land revenue. Up to 1902-03 irrigation was given in two harvests, but in that year in more than half of the canal tracts it was restricted to the *kharif*. In 1904-05 the occupiers' rates were enhanced and are now higher than on any other canal in the province. The statistics to which I refer are confined to the Jangal, Tihara, Dhaia, Uncha and Powadh Circles of the Ludhiana Tahsil and the Dhaia Uncha Circle of the Jagraon Tahsil. In two other circles there is irrigation from canals, but it is inconsiderable. The Jagraon Dhaia Uncha and the Ludhiana Jangal Circles now alone get perennial irrigation. During the last four or five years the irrigation outlets have been completely remodelled, and areas within each village have been determined to which canal water can ordinarily be supplied. This alteration is now, I understand, complete.

4. Variations which have occurred in the irrigated areas have been due to three causes. Either the rainfall has been so timely and plentiful that the people have not taken water, or the Irrigation Department, on account of a deficient supply in the river, has been unable to meet the people's requirements, or changes in the arrangements for distribution, such as

remodelling of outlets, have withdrawn water from some lands without immediately benefiting others. In the attached statements I have struck the averages of the years since the introduction of seasonal irrigation, and before then struck six-yearly averages, but I have not been able to separate the years during which alterations in distribution (chakbandi) went on. I have recently inspected a large number of canal-irrigated villages. I find in them all that chakbandi has largely increased the probable stability of irrigation. It has in almost every village occasioned a temporary contraction of the nahri areas and has in many cases changed the irrigated lands from one portion of the village to another. But the outlets have been reduced to the minimum (usually one to each average-sized village), are situated in the most advantageous positions and command definite blocks of the village area. We may therefore take it as reasonably probable that official effort has gone as far as it can go not only in securing a fixed area permanently irrigated in each village, but also in determining within the village what holdings will in all normal cases be sure of irrigation.

5. The statistics given in statement No. II show that violent variations are confined to the years 1891-92, 1892-93, 1893-94, 1894-95, 1896-97, 1899-1900 and 1905-06. In the first four of these years the irrigated cropped areas are much below average; in the others the nahri areas are in large excess of average. These are precisely the years which strike the eye in the rainfall statement. The first four are years of excellent rainfall, when canal water was not required. The last three are exceptionally dry years. In other years variations are very ordinary. In the Jangal Circle, for instance, which is the most typical, as the people have no wells to fall back upon, during the last seven years, exclusive of the abnormal year 1905-06, the nahri cropped area varied by less than $\frac{1}{2}$ per cent. from the average of 14,733 acres. In the same period barani cultivation varied between as much as 30 $\frac{1}{2}$ per cent. below, and 25 per cent. above, the normal cropped area of 56,630 acres. In the Dhaia Uncha of Jagraon within the last seven years the nahri cropped area fell 28 per cent. below the average of the period in 1908-09, when rains were good; otherwise it has never varied as much as 10 per cent. During the same time the barani cropped area once fell 25 per cent. below average and once 26 per cent. In other circles and for other periods similar remarks apply. Generally variations in nahri cropped area are neither so frequent nor so severe as in barani. In normal years the variations are slight: in abnormal years, that is, in years when the rainfall is in large excess or defect, the variations are not comparable with the variations in rain land. My figures do not show that the inability of the Canal Department to supply water when required ever produces variations in irrigation large enough to raise any special assessment problem. They do show that from 1885 onwards irrigation steadily grew; that in the early years it was subject to considerable variations; that later stability increased; and that during the last ten years, though it received a check from the remodelling of outlets, it has, except in abnormal years, when it has always increased, varied within narrow limits.

6. Leaving aside for the present variations due to remodellings and such official action, I do not think that canal irrigation is so unstable as to call for a division of the demand on canal lands into fixed and fluctuating charges. What is to be assessed is land revenue, and not occupiers' rates, and theoretically the decrease of irrigation which occurs here in good years is no justification for diminishing any portion of the land revenue demand. If a cultivator refuses to take water, which the Irrigation Department is ready to supply to him, because the rains have been good, he is obviously calculating on obtaining a crop as abundant as that grown with canal water. The popular opinion is that when canal water is not taken for such reasons, the barani crops are as good as nahri crops, and this year they are supposed to be much better. In such circumstances the yield to the cultivator is at least the same, and his expenses are much less. He should therefore pay to Government not less than if he had taken water, but more. Whether diminutions of the matured irrigated area are due to the action of the people in not taking water, or to the action of the Irrigation Department in not supplying it, they are at any rate much less frequent and severe than the variations of matured cultivation in rain lands, and for them a fixed assessment is admittedly proper.

APPENDIX E.

7. Since receipt of your orders I have discussed the question in detail, and in their villages, with people of 10 villages receiving irrigation in various parts of the district. I do not think I can use better arguments for a moderate fixed nahri-parta than those employed by them. They are not afraid of the fluctuations due to natural causes. They argue that the variations on nahri lands are confined within narrower limits than in the case of barani lands. At the same time, if the worst happens to barani lands, they get no crop at all, and have to pay revenue for unsown fields; whereas if the water-supply fails for nahri lands they at least get a barani crop, and there is something to pay the revenue. If a fixed demand is a reasonable method of assessing rain lands, and they would have no other, it is a thousand times more reasonable for canal lands. Natural variations mean that now and again nahri fields paying a nahri-parta are under barani cultivation, and this they are ready to risk, especially if they have not to pay more when they irrigate a larger area. In practice they work on these ideas. Cash rents are common in all circles except the Jangal Circle. In Ludhiana Dhaia Uncha half the canal lands cultivated by tenants-at-will pay cash rents; in other circles, except Jangal, the proportion is a third or more. The average rate is about 50 per cent. above the barani rent rate, and the invariable rule is that the rent agreed upon is paid, whether canal water is received or not, even whether the land is sown or not. The tenant pays all the occupier's rate, and it is his look-out whether he gets water or not.

8. There are two other plain indications of the cultivators' confidence in the stability of irrigation. Maize is a crop which requires regular and plentiful water and can be grown only on land heavily manured every year. It used to be the all-important crop in the well lands lying close round the village site which receive plentiful manure. Now, however, the mai area has been shifted to the nahri lands often at a great distance from the "abadi". In many villages the lands round the site are kept for wheat alone, and the maize lands, which require years of preparation and are always double-cropped, lie in the canal commanded area and are cultivated with canal water. In Jagraon, for instance, where maize has always been the most valued crop, its cultivation on well land has decreased, though wells have risen 2½ per cent., while its area on nahri lands is almost double that on chahi.

If the assessment on canal lands is to be partly fixed and partly fluctuating, the total fixed demand for each village will include an assessment on nahri only in its unirrigated aspect. This demand the people have already decided to distribute over holdings by soil-rates, assessing nahri somewhere between chahi and barani. We thus get back a fixed nahri-parta. We cannot fix the occupiers' rates at any pitch which will in even the average village cause the zamindars to put the same demand on nahri as on barani, and we would probably be reduced to the position of taking through occupiers' rates what we think the fair difference between nahri and barani, *plus* the difference which the people, who will not be able to calculate the effect of the new water-rates, will certainly make in the distribution over holdings.

9. At present, for the purposes of occupiers' rates, the district lies all in one zone of the area commanded by the Sirhind Canal. The circles irrigated have usually a firm good soil, but sand-banks run across each circle in a very capricious way and in very undefined directions. The Jangal Circle in particular is a maze of sand-hills and drifts with blocks of excellent soil. Adjoining villages differ sometimes as the poles. It will be necessary to diverge from rates widely in the case of many villages. As the Government of India point out, this cannot be done to the necessary extent if part of the nahri demand is included in a uniform schedule of occupiers' rates. Not less than four schedules would be necessary, and even then sufficient differentiation would not be attainable.

10. The only case in which the zamindars would agree to an alteration of the demand is the case of alteration of outlets. They have just experienced the disturbing effects of "chakbandi" when canal lands pay no extra demand, and they are not satisfied that the present arrangements will be permanent. I have seen in a great many villages here and elsewhere what a disturbing

APPENDIX E.

effect chakbandi has, and I do not think any nahri-parta, even the most moderate, would be fair unless provision were made for such changes. In most cases there would be very little fear of the total irrigated area of a village being seriously diminished, and section 52 (2) of the Land Revenue Act seems to provide sufficiently for a redistribution of the total demand over holdings on any serious change taking place. But if a nahri-parta is sanctioned, provision will have to be made for altering the total demand of any village in which notable alterations in the facilities for irrigation have been made. What extent of change would demand a change of assessment will depend very much on the pitch of the demand, which cannot readily be forecasted, but it should not be difficult to fix a danger limit. In any case it is not likely that radical alterations in the present system of distribution will take place. If some suitable arrangement is devised for such extraordinary changes, the rest is very largely a question of what years should be adopted as the basis of our assessment statistics. At the present moment chakbandi has given irrigation a check, and our measurement and girdawari figures will be very favourable to the people. If still further caution is desirable, we can exclude from calculation the dry years in which irrigation rose.

11. I propose, then, to assess canal-irrigated lands to a moderate fixed nahri-parta, basing the calculations on recent years when the irrigated area was low, and providing for the reduction of the total village demand when facilities are withdrawn, and for a redistribution over holdings when the irrigated area shifts within the village. I do not propose a fluctuating khush-haisiyati because the fluctuations of the irrigated area do not justify it; the people do not want it; it would prevent a just distribution of the circle demand over villages; and because it would be largely stultified in the distribution over holdings.

12. I have not attempted to forecast the pitch of the proposed nahri-parta, but from rough produce and cash rent estimates which I have made it is clear that we will not be able to take anything like the enhancement that is due. The new demand will probably bring out a rate on nahri lands which can quite easily be paid in the years when nahri lands bear an average barani crop.

13. Since writing the above, I rechecked the statistics appended, and find that the decrease of irrigation in 1908-09, when the rainfall was excellent, extended not only to the Dhaia Uncha of Jagraon, but to all the circles. The argument is not, however, vitiated. The only question that arises is whether that year should be included in the years on which our assessment statistics would be based.

APPENDIX E.

Statement No. I of Rainfall, Tahsil Jagraon.

YEARS.	June	July.	August.	September.	Total of 4 months.	October.	November.	December.	January.	February.	March.	April.	May.	Total of 5 months.	Total of the year.
1887-88 ..	·60	3·39	11·35	2·18	17·47	·50	.	·19	1·10	1·14	·31	...	...	3·15	20·62
1888-89 .	1·08	8·05	4·54	1·80	15·42	·04	.	·02	1·30	3·88	·14	·01	·59	5·04	20·46
1889-90	·90	6·86	3·07	·42	11·31	.	..	...	·3	·10	·51	·32	·23	1·05	12·37
1890-91 ...	2·86	5·28	5·02	·98	14·00	·18	·11	1·68	2·60	1·06	2·54	·59	·19	8·81	22·96
1891-92 ..	7·7	11·87	2·09	1·15	15·88	·77	.	..	1·13	·61	..	.	·71	3·22	19·10
1892-93	·34	5·33	8·96	7·22	21·75	..	.	·84	1·86	2·03	·45	·30	1·47	6·95	26·70
1893-94	3·91	10·45	1·71	18·93	29·00	..	...	..	2·03	1·71	·32	...	·86	4·42	33·42
1894-95	12·34	11·68	10·30	2·57	36·89	..	..	1·63	2·51	·50	·34	·55	·64	6·23	43·12
1895-96	2·02	0·24	0·39	...	14·05	·03	..	...	·89	1·38	06	...	·23	2·59	17·24
1896-97	1·31	4·89	2·77	·11	8·61	·24	·05	·87	·64	·45	·13	1·8	·07	3·46	12·07
1897-98 ..	·42	5·12	4·80	2·16	12·59	·17	..	·08	54	4·08	..	..	·26	5·08	17·67
1898-99 .	3·03	13·68	·48	1·05	18·84	...	...	·71	...	·18	·01	·51	·39	1·80	20·64
1899-1900 ...	4·16	4·02	2·35	.	10·53	·25	...	...	1·05	·18	·14	1·31	13	2·96	13·49
1900-01 ...	1·18	3·78	10·22	14·82	31·90	..	...	·49	2·44	1·92	·06	·28	·61	6·40	38·80
1901-02 ...	·01	0·00	7·12	3·73	17·46	...	...	·28	...	...	·06	·03	2·15	2·41	19·87
1902-03 ...	·94	6·35	6·09	·27	14·65	0·29	..	..	·90	...	1·02	·01	·50	3·41	18·08
1903-04 ...	·01	7·95	3·32	3·80	14·08	·20	...	·20	·42	...	3·29	..	..	4·11	18·19
1904-05 ...	·92	2·75	5·65	8·69	18·01	·11	·36	2·00	1·63	1·62	·35	...	...	6·23	24·24
1905-06 ...	1·22	4·35	1·13	2·75	9·15	...	...	·32	·21	2·40	2·68	...	..	5·61	15·06
1906-07 ...	2·06	3·58	8·61	7·68	21·93	..	...	1·04	·87	3·66	1·37	2·29	...	9·87	31·30
1907-08 ...	·84	6·23	14·95	...	22·02	.	.	...	2·17	·19	...	1·41	·20	3·97	25·89
1908-09 ...	·05	7·82	16·17	·53	24·17	...	..	·12	·23	·29	...	4·18	...	4·82	28·89
Total of 21 years.	40·48	144·67	139·08	76·37	400·80	2·76	·52	10·30	24·61	26·54	14·87	12·74	8·56	101·10	501·70
Average ...	1·93	6·90	6·62	3·63	19·08	·13	·02	·49	1·18	1·26	·71	·61	·41	4·81	23·89
GAZETTED AVERAGE.	1·88	6·14	5·16	3·22	16·88	·10	·01	38	1·13	90	·28	·35	·44	3·54	19·92

LUDHIANA :
The 29th December 1909.

J. M. DUNNETT,
Settlement Officer, Ludhiana.

Statement No. I-a of Rainfall, Tahsil Ludhiana.

YEARS.	June.	July.	August.	September.	Total of 4 months.	October.	November.	December.	January.	February.	March.	April.	May.	Total of 6 months.	Total of the year.	
1887-88	2.12	5.45	13.11	5.89	26.57	.21	..	.	1.32	.15	.50	..	...	2.18	28.76
1888-89	1.84	6.60	6.50	6.09	21.03	..	.50	...	1.85	3.17	...	..	.20	5.72	26.75
1889-90	.79	10.30	6.76	1.26	19.11	.	...	.	.23	.10	1.93	.50	...	2.78	21.87
1890-91	3.72	8.96	5.20	.41	18.29	.03	.45	1.01	5.53	63	2.50	.26	.56	10.97	29.26	
1891-92	1.08	3.32	3.88	4.27	12.55	1.56	.	...	.52	.52	.15	.10	.78	3.63	16.18
1892-93	.87	7.49	12.07	12.76	33.59	.	..	.88	1.86	3.83	92	.71	1.80	10.00	43.59
1893-94	2.33	10.15	2.28	7.57	22.33	...	...	.	2.68	1.20	.48	...	.48	4.84	27.17
1894-95	13.32	8.17	5.43	3.35	30.27	...	..	4.53	2.17	.65	.14	.36	.13	8.28	38.55
1895-96	8.16	1.87	7.91	..	17.94	...	...	...	.50	1.24	..	.	.02	1.96	19.70
1896-97	1.52	3.31	7.54	.56	13.33	.15	.02	.65	.53	.99	.14	1.39	...	3.87	17.20	
1897-98	2.04	9.93	4.08	1.88	17.43	.02	.	...	.55	3.59	..	..	.13	4.29	21.72
1898-99	2.12	12.22	1.40	2.52	18.26	.	..	1.81	...	.24	...	.35	...	2.40	20.66
1899-1900	2.85	4.63	.96	.43	8.87	.30	.	...	1.44	.23	...	2.06	.15	4.18	13.05
1900-01	1.34	4.78	22.98	8.98	38.08	.	..	1.41	2.96	3.29	.67	.25	1.23	9.81	47.89	
1901-02	.52	9.06	10.17	.34	20.09	..	...	.04	...	...	.15	1.00	1.78	2.97	23.06
1902-03	1.92	6.04	3.85	7.03	18.84	.03	.	...	1.51	..	1.39	.14	.58	3.65	22.49
1903-04	.02	5.10	6.51	5.15	16.78	..	...	.65	1.03	..	3.90	...	.75	6.93	23.11
1904-05	.64	1.21	3.64	3.64	9.13	.30	.52	1.05	1.88	2.87	1.40	...	..	8.02	17.15
1905-06	.23	5.73	3.05	1.97	10.98	.41	..	.21	.18	2.95	3.66	.21	.11	7.72	18.71	
1906-07	1.23	4.45	5.17	5.57	16.42	...	.	1.22	1.05	5.87	3.04	2.23	.07	13.41	29.83
1907-08	.88	3.59	17.63	.59	22.69	...	...	...	2.96	.51	.08	1.25	.36	5.17	27.85
1908-09	.89	7.51	14.21	.40	23.01	...	.05	.08	2.27	.45	...	1.89	.05	4.79	27.80
Total of years.	21	50.23	139.87	164.93	80.56	435.59	8.01	1.54	13.54	83.32	32.41	21.05	12.71	9.18	126.76	562.35
Average	...	2.39	6.66	7.85	3.84	21.74	.14	.07	.85	1.59	1.54	1.00	.61	.44	6.04	26.78
GAZETTED AVERAGE.		2.50	8.61	6.59	3.70	21.46	.81	.08	.73	1.44	1.11	1.14	.65	.85	6.79	28.25

LUDHIANA :

The 29th December 1909,

J. M. DUNNETT,

Settlement Officer, Ludhiana.

APPENDIX E.

Statement No. II, Abstract of nahri and barani area cropped by assessment circles under canal irrigation, Ludhiana and Jagraon Tahsils.

YEARS.	LUDHIANA.								JAGRAON.		REMARKS.
	Dhaia Uncha.		Tihara.		Powadh.		Jangal.		Dhaia Uncha		
	area	area	area	area	area	area	area	area	area	area	
	Cropped nahri.	Cropped barani.	Cropped nahri.	Cropped barani.	Cropped nahri.	Cropped barani.	Cropped nahri.	Cropped barani.	Cropped nahri.	Cropped barani.	
	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	
1885-86	1 018	68,892	211	53,818	..	19,736	..	63 660	11,116	140,485	
1886-87	1,098	77,384	2,501	48 616	17	19,014	307	52,033	8,822	140,690	
1887-88	3,724	71,293	3,054	49,808	161	20,544	3 348	55,380	13,973	139,241	
1888-89	4,121	69,697	3,618	52,326	60	19,198	7,833	55,757	16,556	138,972	
1889-90	4,721	60,768	5,984	40,635	17	17,369	10,150	46,740	28,019	109,231	
1890-91	7,525	61,770	6,137	47,575	102	16,040	12,585	48,520	24,313	131,707	
Total of 6 years	22,207	469,804	22,455	292,808	357	112,801	34,223	322,092	103,090	800,279	
Average	3,701	68,301	3 734	48,802	59	18,500	5,701	53,682	17,182	133,380	
Percentage to cultivated area.	3.93	72.54	5.75	75.13	.21	66.38	9.32	87.72	10.56	82.01	
1891-92	2,918	66,257	3,161	49,457	59	18,413	14,365	48,335	19,544	131,396	
1892-93	4,717	76,086	3,085	53,841	187	21,753	5,695	57 960	10,272	151,220	
1893-94	5,740	67,927	4,223	51,566	185	20,356	6,383	58,123	15,558	141,056	
1894-95	4,946	75,662	2,856	53,326	154	21,852	7,234	55,034	13,181	142,582	
1895-96	9,381	54,070	5,009	46,219	235	16,438	16,129	22,851	15,272	141,022	
1896-97	12,648	51,450	10,758	28,201	468	11 006	19,722	6,140	46,915	60,327	
Total of 6 years	40,350	391,452	29,092	282,600	1,288	109,818	69,528	243,443	121,372	771,605	
Average	6,725	65,242	4,849	47,100	215	18,308	11 588	40,574	20,229	128,484	
Percentage to cultivated area.	7.07	68.55	7.37	71.50	.74	62.97	18.80	65.85	12.32	78.22	
1897-98	3,883	64,514	2,984	43,105	230	16,691	18,558	35,151	33,880	122,212	
1898-99	8,588	61,592	8,344	41,770	302	16,168	16,741	14,577	33,405	114,801	
1899-1900	13,816	17,299	10,829	15,008	757	3,759	18,756	2,272	48,774	48,069	
1900-01	9,601	72,857	6,683	51 303	505	20 885	15,646	48,997	26,904	138,519	
1901-02	9,894	52,052	7,380	35,610	619	13,480	12,654	4,897	33,185	106,843	
Total of 5 years	45,782	268,314	36,120	186,892	2,613	70,063	82,355	105,891	176,158	530,444	
Average	9,156	53,663	7,224	37,378	523	14 193	16,471	21 179	35,232	106,089	
Percentage to cultivated area.	9.60	56.26	11.01	56.98	1.77	48.64	56.50	34.68	21.49	64.69	
1902-03	5,255	63,867	4,371	43,410	628	17,323	14,613	25,722	27,782	121,168	
1903-04	5,049	66,703	4,049	48,628	661	18,464	14 076	44,139	26,298	127,942	
1904-05	5,717	69,345	4,542	48,454	754	19,233	14,335	45,020	25,713	127,001	
1905-06	9,401	43,208	7,442	23,350	1,037	8,327	17,306	23,979	27,583	82,583	
1906-07	4,611	68,009	5,863	45,990	1,060	19,901	15 470	45,852	24,853	125,841	
1907-08	5,367	29,324	4,530	26,525	957	11,148	14,215	27,551	23,882	80,895	
1908-09	5,261	57,781	3,024	41,051	876	17,079	9,414	37,658	19,129	117,498	
Total of 7 years	40,661	396,787	33 821	277,408	5,993	111,475	99,629	249,891	185,240	782,228	
Average	5 809	56,677	4,832	39,631	856	15,925	14,233	35,842	26,463	111,747	
Percentage	6.13	59.62	7.46	61.17	2.34	54.79	22.94	57.76	16.29	68.80	

LUDHIANA :

The 29th December 1909.

J. M. DUNNETT,

Settlement Officer, Ludhiana.

APPENDIX E.

No 542-S. (Rev. & Agri.—Rev.), dated Simla, the 10th June 1910.

From—The Hon'ble Mr. E. D. MACLAGAN, C.S.I., I.C.S., Chief Secretary to Government, Punjab,

To—The Secretary to the Government of India, Department of Revenue and Agriculture

In your letter No. 1496-451-2, dated the 5th November 1908, it was stated that before accepting the forecast of the financial results of the re-settlement of the Ludhiana District, the Government of India would be glad to be informed of the decision of the Punjab Government in the matter of the assessment of canal-irrigated lands. It was added that in coming to that decision, the Local Government would doubtless consider the instructions given by the Government of India in their letter No. 1717-C.W.-I., dated the 1st December 1904.

2. The orders of the Government of India were forwarded to the local officers for report in November 1908, and subsequently, when communicating in November 1909 the orders of the Government of India regarding the Amritsar settlement, the Lieutenant-Governor drew attention to the instructions which had in the meantime been received from the Supreme Government on the subject of the assessment of canal-irrigated land in the Delhi Division. I am now to enclose a copy of letter No. 180 of 23rd March 1910 from the Financial Commissioner, Punjab, with its enclosures, in which he submits his recommendation on the subject dealt with in your letter under reply.

3. The canal-irrigated lands on the Sirhind Canal are at present subject to the schedule of occupiers' rates fixed in 1904, and the land revenue assessed on them is imposed at dry rates. The Financial Commissioner proposes to leave the scale of occupiers' rates in the Ludhiana District untouched, merely applying the rates of zone II to villages where special leniency is necessary, and to assess the canal-irrigated lands to land revenue at rates slightly higher than the ordinary dry rates. In view of the relation borne by the occupiers' rates on the Sirhind Canal to those in force elsewhere, the Lieutenant-Governor agrees that their enhancement is undesirable, and by leaving the occupiers' rates as they are, a further advantage is gained in so far as difficulties are avoided in connection with the large irrigated areas in the adjoining Native States which have recently been brought under assessment. The Lieutenant-Governor also accepts the view that the land revenue should be assessed on canal-irrigated lands at rates in excess of the ordinary barani rate. Rules will be made for varying the nahri assessment in cases of remodelling, and in view of the fact that the new settlement will probably like the last, be for a period of 30 years, it will be necessary, in spite of what is said in paragraph 9 of the Financial Commissioner's letter, to reserve power to Government to provide for possible extensions of irrigation and possible increases of supply from storage reservoirs. So far therefore as the Ludhiana District is concerned, the Lieutenant-Governor accepts, subject to the above modification, the system of assessment proposed by the Financial Commissioner.

4. Provision should also be made for the grant in cases where the people are prepared to accept them of lump contracts for short terms in place of the fluctuating occupiers' rates, such contracts being based on the averages of a series of past years.

No 543-S (Rev. & Agri.—Rev.).

COPY, with a copy of the marginally-noted proceedings forwarded to the

<p>(a) Proceedings, <u>R. & A.</u>, October 1908, Nos. 33-41-A.</p> <p>(b) Proceedings, <u>R. & A.</u>, November 1908, Nos. 33-4-A.</p> <p>(c) Financial Commissioner's No. 180, dated, 23rd March 1910, and enclosures.</p>	<p>(1) Senior Secretary to the Financial Commissioner, Punjab, for</p> <p>(2) Chief Engineer, Irrigation Branch, for information.</p> <p>the information of the Financial Commissioner, with reference to his letter No 180, dated the 23rd March 1910 (sub-head 91, file No 520).</p>
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APPENDIX E.

RULES FOR FUTURE INCREASES OR DECREASES OF NAHRI-PARTA.

No. 332, dated Simla, the 19th May 1910.

From—E. R. ANNOTT, Esq., Senior Secretary to the Financial Commissioner, Punjab,
To—The Chief Secretary to Government, Punjab.

I AM directed to refer you to Mr. Fenton's letter No. 256, dated 19th November 1909, and to submit a copy of letter No. 162, dated 3rd November 1909, from the Settlement Commissioner, with its enclosure (not including the draft rules forwarded), and a copy of letter No. 365, dated 5th February 1910, from the Settlement Commissioner, with enclosures, and to say that, as this is the first set of rules for future increases and decreases of nahri-parta, Mr. Douie thinks it advisable to lay the proposed rules before Government, together with a revised draft. The notes appended to the latter draft show the reasons for the changes made.

2. Rule 9 of the original (rule 10 of the revised) draft brings us to one great difficulty connected with the scheme. In many estates the landowners have disregarded in the *bachh* the differential assessment on nahri land, and have adopted an all-round rate. Obviously any addition must be spread rateably over all holdings unless an entirely new *bachh* is demanded. But it will be very hard to persuade A that he should pay more on his holding because B's holding has got more irrigation.

3. Mr. Douie feels considerable doubts whether the plan embodied in these rules will be successfully worked. Experience shows that exceptional arrangements for the purpose of adding to or reducing an assessment within the period of a land revenue settlement, as apart from general fluctuating assessments, are apt not to be carried out effectively. This was the fate of Mr. Casson Walker's rules for reduction of assessment on wells falling out of use in Sharakpur and of Mr. Douie's own rules on the same subject in Karnal-Ambala. It was also the fate, Mr. Douie believes, to a considerable extent of the rules for increase and reduction of nahri-parta assessments on the Bari Doab Canal approved by Sir James Lyall. The present plan is simpler than that sanctioned for the Bari Doab Canal, but still it involves much work and constant vigilance. The Financial Commissioner thinks it would be wise to limit the operation of the rules to estates in which irrigation is considered by the revenue and irrigation officers concerned not to be fully developed. Mr. Douie fears that in tracts like that watered by the Delhi branch of the Western Jumna Canal, where irrigation is long established, the rules will cause much trouble with little result.

4. Personally Mr. Douie would have preferred a system under which villages or chaks in villages in which irrigation was fully developed were marked off, and outside these villages and chaks new irrigation (*i.e.*, fields not recorded as nahri at settlement bearing at any time an irrigated crop) was made to pay during the term of settlement a fluctuating land revenue rate on matured crops of 3 annas an acre. The actual result would probably be a larger income than the plan approved will yield, and that result would be obtained with less trouble.

REVISED DRAFT RULES.

1. In making the changes of soil classification prescribed by the note regarding column 7 of the *jamabandi* form (paragraph 22 of standing order No. 23), no field or part of a field—

- (a) shall be converted from *barani* to *nahri* unless the *khasra girdawari* shows it to have been irrigated in two out of the four years ending with that to which the *jamabandi* relates;
- (b) shall be converted from *nahri* to *barani* unless it has not been irrigated in the year to which the *jamabandi* relates, and likewise in the two preceding years.

2. If only part of a field has been converted from *barani* to *nahri* or *vice versa*, no change of classification shall take place if the area affected is less than one *pacca bigha*.

APPENDIX E.

3. The new entry of nahri in place of barani or barani in place of nahri shall be made by the patwari in red ink. The field kanungo shall see that the changes made are in accordance with rule 1, and shall sign the new entry. He shall further, by an examination of the khasra girdawari, satisfy himself that a change of entry has been made by the patwari wherever such a change was required. He shall carefully check the totals of nahri and barani entered at the end of the jamabandi, and shall attest them with his signature. In his note on changes in soil entries attached to the jamabandi (see instructions appended to the jamabandi form in paragraph 22 of standing order No. 23) he shall state exactly what he has done to ensure correct entries. In attesting jamabandis, tahsildars and naib-tahsildars must pay special attention to those new soil entries.

4. When the total of the nahri area differs from that shown in the last jamabandi, the field kanungo shall apply to the excess area or to the reduction of area, as the case may be, one of the following rates :—

(a) In villages which were canal-irrigated at settlement, the difference between the Settlement Officer's assessment rates on nahri and barani.

(b) In villages to which canal irrigation has been extended since settlement, 4 annas per acre.

5. If an additional nahri assessment under these rules has already been imposed on, or a reduction made in, a village at a previous quadrennial attestation, the area to which the rate referred to in the preceding paragraph will be applied will be the excess or reduction of area since the last imposition or reduction of nahri assessment. If no previous assessment has been imposed or reduced, the area will be the excess or reduction of area since last settlement.

6. If the sum resulting from the application of the rates detailed in rule 4 to the area defined in rule 5 is less than Rs. 50 or than $\frac{1}{16}$ th of the revenue of the village (whichever is less), no further action will be taken, but the field kanungo will note the result of the calculation in his attestation note on the jamabandi, and the tahsildar or naib-tahsildar who attests the jamabandi should check the calculation, and should state in his attestation note that he has done so.

7. If the above sum amounts to Rs. 50 or more, or, in villages the revenue of which is less than Rs. 500, to $\frac{1}{16}$ th of the revenue of the village or more, the patwari will prepare a list in the following form and forward it to the field kanungo. After it has been checked and signed by the latter and by the Revenue Officer of the circle, it will be forwarded to the tahsildar unless he is himself the Revenue Officer of the circle :—

List of fields converted from barani to nahri and vice versa with additional nahri assessment.

Patwari Circle					Tahsil				for the year 19 .								
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Serial No.	Topographical No.	Name of village.	No. of jamabandi holding.	Name of owner, with description, briefly.	Name of cultivator, with description, briefly.	FIELD NUMBER AND AREA CONVERTED				NAHRI ASSESSMENT			NET INCREASE OR DECREASE OF NAHRI ASSESSMENT.				REMARKS.
						From barani to nahri.		From nahri to barani.		Rate	To be imposed	To be reduced.	Plus or minus.	Land revenue.	Cesses.	TOTAL.	
						Field No.	Area.	Field No.	Area.								

NOTE.—Columns 7 and 9.—If part of a field is affected, the word "min" should be added. If a whole holding is affected, no detail of field numbers is required; the words "entire khata" are sufficient. Columns 8 and 10.—Total of the village acres should also be noted in red ink. Column 11.—For rate see rule 4. It will be uniform for the village concerned. Columns 12, 13, 16 and 17.—Detail of math, if any, should be noted in red ink.

APPENDIX E.

8. On receipt of the detailed statement, the tahsildar shall have an abstract for the tahsil prepared in duplicate by the wasil-baki-navis in the form below. After signature, a copy of the abstract, with the detailed statements, will be forwarded by the tahsildar to the Collector so as to reach his office not later than 31st July :—

Abstract showing nahri assessment payable on account of extensions of canal irrigation or remissible on account of reductions of the same in
Tahsil , District , for the year 19 .

1	2	3	4	5	6	7	8	9	10	11	12	13
Serial No.	Topographical No.	Name of village.	ADDITIONAL NAHRI ASSESSMENT TO BE IMPOSED.			NAHRI AS- SESS- MENT TO BE REDUCED.		AMOUNT OF LAND REVENUE PAYABLE BY THE VILLAGE FROM KHARIF 19				REMARKS
			Area in acres converted from barani to nahri	Rate.	Land revenue	Area in acres converted from nahri to barani.	Land revenue at rate given in column 5.	Land revenue.		Cesses.	Total.	
								Khalas.	Nahi			

9. After the statements have been checked in his office, the Collector shall report the amount of the assessment to be imposed and to be reduced, through the Commissioner, for the sanction of the Financial Commissioner, and on receipt of sanction, he will return the detailed statements to the tahsildar ordering him to have the addition to, or the reduction from, the assessment incorporated in the kharif bachh.

10. In incorporating the changes due to addition or reduction of assessment in the bachh, the patwari will adopt the following principles :—

- (a) In villages where the assessment on nahri and barani is distributed at an all-round rate, he will spread the total amount of the revised assessment over all the holdings previously paying at an all-round rate.

Any landowner who objects may apply to the Collector to revise the bachh of the estate or sub-division of the estate under section 51(2) of the Land Revenue Act.

- (b) In villages where the assessment on nahri and barani is distributed by differential soil-rates, the patwari shall impose or reduce the nahri rate on or from the holdings affected, taking the details from the statement in rule 7.

11. Field kanungos and Revenue Officers must carefully check the patwari's bachh work, and see that the above orders are correctly carried out.

Notes.

(Rules in Original Draft are referred to.)

Rule I.—This is based on the definition of nahri adopted in the Gurgao settlement, as given in paragraph 4 of the Palwal assessment report. It will be observed, however, that land was recorded as nahri if it was irrigated at the time of measurement, whether or not it had been irrigated in two out of the four years ending 1902-03.

APPENDIX E.

Old nahri should not be treated as having ceased to be nahri simply because it has not been irrigated twice in the preceding four years if it is actually irrigated in the year of quadrennial attestation. It is reasonable enough to exempt a field irrigated for the first time in the year to which the jamabandi relates, for irrigation in that case may only be tentative.

Rules 3, 4, 5.—See paragraph 5 of Government review of Palwal assessment report.

In order to avoid the preparation of detailed statements for every estate in which changes occur, the Settlement Officer has provided that the field kanungo, on the basis of his own note regarding changes in soil entries appended to the jamabandi, shall make a calculation in order to ascertain whether any addition or reduction is required. In making this calculation, all that he will have before him will be the former and present totals of nahri area as shown in the jamabandi. If the patwari is careless or dishonest, and the kanungo fails to exercise a proper check, we may have failures to record fields as nahri which have become harani and *vice versa*; we may also have changes of entry made not justified by rule 1, and finally, we may have wrong totals. It is essential to give the kanungo and his superiors definite instructions, and accordingly, before Mr. Gibson's draft rule 3, a new rule, given as 3 in the revised draft, has been inserted.

Rule 8.—The rule is badly worded. An "additional assessment" cannot lead to a reduction in the bachh.

No. 4132, dated Lahore, the 30th November 1909.

From—A. H. DIACK, Esq., Settlement Commissioner, Punjab,

To—The Senior Secretary to the Financial Commissioner, Punjab.

I SUBMIT herewith, for the orders of the Financial Commissioner, a copy of a letter No. 561, dated 4th September 1909, from the Settlement Officer of Gurgaon, together with a copy of his draft rules for the assessment during the term of settlement of new irrigation from the Agra Canal.

2. I have hitherto kept this letter pending the receipt of orders on the reference made in my letter No. 1590, dated 1st May 1909, on the subject of the assessment during the new term of settlement of new irrigation from the Western Jumna Canal. Orders have not reached me, but I understand that the recommendation which was made in paragraph 5 of my letter, that the assessment of such irrigation should be determined by applying the sanctioned rate of assessment to the average area irrigated, and not to the area recorded as nahri, has not been accepted. The rules drafted by Mr. Gibson contemplate the calculation of the assessment on the recorded area, and appear to me to be appropriate for that purpose. I therefore recommend them for approval.

No. 561, dated Gurgaon, the 4th September 1909

From—B. T. GIBSON, Esq., Settlement Officer, Gurgaon,

To—The Settlement Commissioner, Punjab

WITH reference to paragraph 2 of your letter No. 2262, dated 12th July 1909, I have the honour to inform you that as this settlement expires at the end of the current month, I have thought it better to frame and submit draft rules for the reimposition of an additional assessment on extensions of canal irrigation without waiting further for the orders of Government on the report submitted by Mr. Joseph.

2. If the original orders of Government are cancelled or modified, then my proposed rules can be cancelled or returned for modification, if necessary.

3. The rules explain themselves, and do not require much comment. Rule 1 should remove the difficulty complained of by Mr. Joseph that soil changes made by patwaris cannot be taken as a basis for the additional assessment. It is true that the additional assessment will be on the commanded area, while the original assessment was imposed on the area of average irrigation, but

APPENDIX E.

the rate of assessment to be imposed is so small that there can be no objection to imposing it on the commanded area. The only other point to which I wish to draw attention is rule 9 about the bachh. Where the nahri and barani assessments have been distributed at an all-round rate, it would not be fair to impose the additional assessment only on the holdings newly-irrigated, as they are already paying their share of the nahri assessment imposed on the owners who have land classed as nahri at settlement.

No. 365, dated Lahore, the 5th February 1910.

From—The Hon'ble Mr. A. H. DRAKE, C.V.O., Settlement Commissioner, Punjab,
To—The Senior Secretary to the Financial Commissioner, Punjab.

IN continuation of this office letter No. 4162, dated 30th November last, I have the honour to forward a copy of a letter from the Deputy Commissioner of Gurgaon, No. 61, dated 12th January 1910, together with a copy of the amended rules for imposition or reduction of nahri assessment on extensions or contraction of canal irrigation, and to recommend that the rules now submitted be approved in place of those sent with my previous letter.

No. 61, dated Gurgaon, the 12th January 1910.

From—B. T. GINSON, Esq., Deputy Commissioner, Gurgaon,
To—The Settlement Commissioner, Punjab.

WITH reference to your endorsement No. 4163, dated 30th November 1909, I have the honour to submit revised rules for the working of the nahri-parta in accordance with the subsequent instructions issued in letter No. 256-Revenue, dated 19th November 1909, from the Chief Secretary to Government, Punjab, to the Senior Secretary to the Financial Commissioner.

2. The only changes required by the orders relate to (a) reduction, as well as addition, of the nahri-parta (paragraph 3 of the Government orders); (b) alteration of the Rs. 50 rule (paragraph 4 of the same orders).

3. These changes have been incorporated, and the revised rules are now resubmitted for sanction.

DRAFT RULES FOR IMPOSITION OR REDUCTION OF NAHRI ASSESSMENT ON EXTENSION OR CONTRACTION OF CANAL IRRIGATION.

IN making the changes of soil classification prescribed by the note regarding column 7 of the jamabandi form (paragraph 22 of standing order No. 23), no field or part of a field shall be converted from barani to nahri or nahri to barani unless the khasra girdawari shows it to have been irrigated in the former case and not to have been irrigated in the latter case in two out of the four preceding years.

2. If only part of a field has been converted from barani to nahri or *vice versa*, no change of classification shall take place if the area affected is less than one pacca bigha.

3. When the note of soil changes required by jamabandi form, general instruction (b), is ready in any jamabandi under quadrennial attestation, the field kanungo shall apply to the area converted from barani to nahri or *vice versa* (if any) one of the following rates:—

(a) In villages which were canal-irrigated at settlement, the difference between the Settlement Officer's assessment rates on nahri and barani.

(b) In villages to which canal irrigation has been extended since settlement, 4 annas per acre.

APPENDIX E.

4. If an additional nahri assessment under these rules has already been imposed on, or reduced in, a village at a previous quadrennial attestation, the area to which the rate referred to in the preceding paragraph will be applied will be that which has been converted from barani to nahri or *vice versa* since the last imposition or reduction of additional nahri assessment. If no previous additional assessment has been imposed or reduced, the area will be that which has been converted from barani to nahri or *vice versa* since last settlement.

5. If the sum resulting from the application of the rates detailed in rule 3 to the area defined in rule 4 is less than Rs. 50, or than $\frac{1}{10}$ th of the revenue of the village (whichever is less), no further action will be taken, but the field kanungo will note the result of the calculation in his diary, and the Revenue Officer should carefully test its accuracy.

6. If the above sum amounts to Rs. 50 or more, or, in villages the revenue of which is less than Rs. 500, to $\frac{1}{10}$ th of the revenue of the village or more, the patwari will prepare a list in the following form and forward it to the field kanungo. After it has been checked and signed by the latter and by the Revenue Officer of the circle, it will be forwarded to the tahsildar unless he is himself the Revenue Officer of the circle :--

List of fields converted from barani to nahri and vice versa, with additional nahri assessment.

Patwari Circle

, Tehsil

, for the year 19 .

[illegible]

Notes.—Columns 7 and 9.—If part of a field is affected, the word "min" should be added. If a whole holding is affected, no detail of field numbers is required; the words "salim khata" are sufficient.
Columns 8 and 10 in total of the village acres should also be noted in red ink.
Column 11.—For rate see rule 4: It will be uniform for the village concerned.
Columns 12, 13, 15 and 17.—Detail of mañ, if any, should be noted in red ink.

APPENDIX E.

7. On receipt of the detailed statement, the tahsildar shall have an abstract for the tahsil prepared in duplicate by the wasal-baqi-nawis in the form below. After signature a copy of the abstract, with the detailed statements, will be forwarded by the tahsildar to the Collector so as to reach his office not later than 31st July :—

Abstract showing (additional) nahri assessment payable on account of extensions of canal irrigation or remissible on account of reductions of the same in Tahsil , District Gurgaon, for the year 19 .

1	2	3	4	5	6	7	8	9	10	11	12	13
Serial No.	Topographical No.	Name of village.	ADDITIONAL NAHRI ASSESSMENT TO BE IMPOSED.			NAHRI ASSESSMENT TO BE REDUCED.		AMOUNT OF LAND REVENUE PAYABLE BY THE VILLAGE FROM KHARIF 19 .				REMARKS.
			Area in acres converted from barani to nahri.	Rate.	Land revenue.	Area in acres converted from nahri to barani.	Land revenue at rate given in column 5.	Khalsa.	Land revenue.	Maf.	Cerees.		TOTAL.

8. After the statements have been checked in his office, the Collector shall report the additional assessment to be imposed and to be reduced, through the Commissioner, for the sanction of the Financial Commissioner, and on receipt of sanction he will return the detailed statements to the tahsildar, ordering him to have the additional assessments incorporated in, and reduced from, the kharif bachh, and the net result given effect to in the next fixed rent roll.

9. In incorporating the changes due to addition or reduction of assessment in the bachh, the patwari will adopt the following principles—

In villages where the assessment on nahri and barani is distributed at an all-round rate, he will spread the total amount of the revised assessment over all the holdings previously paying at an all-round rate. In villages where the assessment on nahri and barani is distributed by differential soil-rates, the patwari shall impose or reduce the nahri rate on or from the holdings affected, taking the details from the statement in rule 7. Field kanungos and Revenue Officers must carefully check the patwari's bachh work, and see that the above orders are correctly carried out. If the landowners of the villages in question object to the above method of redistribution, their objections should not be listened to unless they are prepared to apply for revision of the method of distribution sanctioned at settlement.

No. 231 (Rev. & Agri—Rev.), dated Lahore, the 9th June 1910.

From—The Hon'ble Mr. E. D. MACLEAGAN, C.S.I., Chief Secretary to Government, Punjab,

To—The Senior Secretary to the Financial Commissioner, Punjab.

IN reply to your letter No. 332, dated the 19th May 1910 (sub-head 251, file No. 452), I am directed to say that the Lieutenant-Governor approves generally of the revised draft rules for future increases and decreases of nahri-parts forwarded therewith, subject to the following suggestions.

2. In rule 10 (a) His Honour would be disposed to say that in cases where there has been a summary bachh, the extra nahri assessment imposed in villages in which canal irrigation has increased or diminished since settlement should be added to, or remitted from, the amount actually bachhed on the holding. This would greatly simplify matters and prevent applications for fresh general bachhes. The rules might also provide that the statement should be seen by the Executive Engineer, Canal Department, before orders are passed

APPENDIX E.

by the Deputy Commissioner. This will probably prevent increases of assessment being ignored, as has been the case elsewhere.

3. The rules, if modified to meet the above suggestions, may be issued by the Financial Commissioner.

No 167-S., dated Simla, the 18th June 1910.

From:—E. R. Abbott, Esq., Senior Secretary to the Financial Commissioner, Punjab,
To:—The Chief Secretary to Government, Punjab.

In reply to your letter No. 231 (Rev. & Agri — Rev.), dated 9th June, I am directed to forward a copy of the final rules modified to meet the suggestions of Government. The rules, as modified, have been issued by the Financial Commissioner; the alterations have been italicised in the copy now submitted.

— — —
RULES AS FINALLY SANCTIONED.

1. In making the changes of soil classification prescribed by the note regarding column 7 of the jamabandi form (paragraph 22 of standing order No. 23), no field or part of a field—

- (a) shall be converted from barani to nahri unless the khasra girdawari shows it to have been irrigated in two out of the four years ending with that to which the jamabandi relates;
- (b) shall be converted from nahri to barani unless it has not been irrigated in the year to which the jamabandi relates, and likewise in the two preceding years.

2. If only part of a field has been converted from barani to nahri or *vice versa*, no change of classification shall take place if the area affected is less than one pacca bigha.

3. The new entry of nahri in place of barani or barani in place of nahri shall be made by the patwari in red ink. The field kanungo shall see that the changes made are in accordance with rule 1, and shall sign the new entry. He shall further, by an examination of the khasra girdawari, satisfy himself that a change of entry has been made by the patwari wherever such a change was required. He shall carefully check the totals of nahri and barani entered at the end of the jamabandi, and shall attest them with his signature. In his note on changes in soil entries attached to the jamabandi (see instructions appended to the jamabandi form in paragraph 22 of standing order No. 23) he shall state exactly what he has done to ensure correct entries. In attesting jamabandis, tahsildars and naib-tahsildars must pay special attention to these new soil entries.

4. When the total of the nahri area differs from that shown in the last jamabandi, the field kanungo shall apply to the excess area or to the reduction of area, as the case may be, one of the following rates:—

- (a) In villages which were canal irrigated at settlement, the difference between the Settlement Officer's assessment rates on nahri and barani.
- (b) In villages to which canal irrigation has been extended since settlement, 4 annas per acre.

5. If an additional nahri assessment under these rules has already been imposed on, or a reduction made in, a village at a previous quadrennial attestation, the area to which the rate referred to in the preceding paragraph will be applied will be the excess or reduction of area since the last imposition or reduction of nahri assessment. If no previous assessment has been imposed or reduced, the area will be the excess or reduction of area since last settlement.

6. If the sum resulting from the application of the rates detailed in rule 4 to the area defined in rule 5 is less than Rs. 50, or than $\frac{1}{10}$ th of the revenue of the village (whichever is less), no further action will be taken, but the field kanungo will note the result of the calculation in his attestation note on the jamabandi, and the tahsildar or naib-tahsildar who attests the jamabandi should check the calculation, and should state in his attestation note that he has done so.

APPENDIX E.

7. If the above sum amounts to Rs. 50 or more, or, in villages the revenue of which is less than Rs. 500, to $\frac{1}{10}$ th of the revenue of the village or more, the patwari will prepare a list in the following form and forward it to the field kanungo. After it has been checked and signed by the latter and by the Revenue Officer of the circle, it will be forwarded to the tahsildar unless he is himself the Revenue Officer of the circle :—

List of fields converted from barani to nahri and vice versa, with additional nahri assessment.

Patwari Circle						. Tahsil , for the year 19												
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
Serial No.	Topographical No.	Name of village.	No of jumabandi holding.	Name of owner, with description (briefly).	Name of cultivator, with description (briefly).	FIELD NUMBER AND AREA CONVERTED				NAHRI ASSESSMENT			NET INCREASE OR DECREASE OF NAHRI ASSESSMENT.				REMARKS.	
						From barani to nahri.		From nahri to barani.		Rate.	To be imposed.	To be reduced.	Plus or minus.	Land revenue.	Cesses.	TOTAL.		
						Field No.	Area.	Field No.	Area.									

NOTES.—Columns 7 and 9.—If part of a field is affected, the word 'part' should be added. If a whole holding is affected, no detail of field numbers is required; the words "salim khata" are sufficient.

Columns 8 and 10 in total of the village area should also be noted in red ink.

Column 11.—For rate see rule 4. It will be uniform for the village concerned.

Columns 12, 13, 15 and 17.—Detail of masi, if any, should be noted in red ink.

8. On receipt of the detailed statement, the tahsildar shall have an abstract for the tahsil prepared in duplicate by the wasil-baki-navis in the form below. A separate abstract will be prepared for each Canal Division concerned. After signature, a copy of the abstract, with the detailed statements, will be forwarded by the tahsildar to the Collector so as to reach his office not later than 31st July :—

Abstract showing nahri assessment payable on account of extensions of canal irrigation or remissible on account of reductions of the same in
Tahsil, District, for the year 19

1	2	3	4	5	6	7	8	9	10	11	12	13	
Serial No.	Topographical No.	Name of village.	ADDITIONAL NAHRI ASSES-MENT TO BE IMPOSED.			NAHRI ASSESSMENT TO BE REDUCED.		AMOUNT OF LAND REVENUE PAYABLE BY THE VILLAGE FROM KHARIF 19					REMARKS.
			Area in acres converted from barani to nahri.	Rate.	Land revenue.	Area in acres converted from nahri to barani	Land revenue at rate given in column 5.	Land revenue.			TOTAL.		
								Khata.	Mafi.	Cesses.			

APPENDIX E.

9. After the statements have been checked in his office, the Collector shall report the amount of the assessment to be imposed and to be reduced, through the Commissioner, for the sanction of the Financial Commissioner, and shall inform the *Executive Engineer of the proposal made, sending him at the same time the abstracts for information and return*. On receipt of sanction, he will return the detailed statements to the tahsildar, ordering him to have the addition to, or the reduction from, the assessment incorporated in the kharif bachh.

10. In incorporating the changes due to addition or reduction of assessment in the bachh, the patwari shall, *whether the assessment on nahri and barani is distributed at an all-round rate or by differential soil-rates, impose or reduce the nahri rate on or from the holdings affected, taking the details from the statement in rule 7*.

11. Field kanungos and Revenue Officers must carefully check the patwaris' bachh work, and see that the above orders are correctly carried out.

APPENDIX E.**RESETTLEMENT OF THE LUDHIANA DISTRICT.**

No. 867-278-2, dated Simla, the 4th August 1910.

From—J. H. KERR, Esq., I.C.S., Deputy Secretary to the Government of India, Department of Revenue and Agriculture,

To—The Chief Secretary to Government, Punjab.

I AM directed to acknowledge receipt of Mr. MacLagan's letter No. 542-S., Revenue, dated the 10th June 1910, on the subject of the resettlement of the Ludhiana District, in which it is stated that the Lieutenant-Governor proposes to leave the scale of occupiers' rates in the district untouched, except for some slight variations, and to assess the canal-irrigated lands to land revenue at rates slightly higher than the ordinary dry rates.

2. In reply, I am to say that the Government of India agree in the Lieutenant-Governor's conclusion that it is undesirable to effect any enhancement of the occupiers' rates. They accept the forecast of land revenue enhancement originally made by the Local Government, subject to the remarks made in paragraph 3 of Mr. Carlyle's letter No. 1496, dated the 5th November 1908, and they have no objection to provision being made for the grant of lump contracts for short terms in place of the fluctuating occupiers' rates in cases where the people are prepared to accept them.

Endorsement by the Punjab Government.

No. 287 (Rev. & Agri.—Rev.), dated Lahore, the 16th August 1910.

Copy forwarded to the—

- (1) Senior Secretary to the Financial Commissioner, Punjab, for the information of the Financial Commissioner, and
 - (2) Chief Engineer, Irrigation Works, Punjab, for information,
- in continuation of the endorsement from this office, No. 542-S., dated the 10th June 1910.
-

APPENDIX E.

PROPOSALS RELATIVE TO THE PARTA ASSESSMENT OF CANAL-IRRIGATED LANDS
IN THE LUDHIANA DISTRICT.

No. 264, dated Lahore, the 27th March 1912.

From—H. S. WILLIAMSON, Esq., Junior Secretary to the Financial Commissioner, Punjab,
To—The Revenue Secretary to Government, Punjab.

I AM directed to submit, for the orders of Government, a copy of a letter No. 6773, dated 15th-18th December 1911, with enclosures, from the Commissioner of Jullundur, on the subject of nahri-parta and occupiers' rates in the Ludhiana District.

2. In regard to the pitch of nahri-parta, the Financial Commissioner agrees in the views expressed in paragraphs 3 and 4 of Mr. Fagan's letter, and he recommends for sanction the rates there proposed.

3. Mr. Diack also agrees with the Commissioner that the Settlement Officer's estimate at Rs. 18,079 of the indirect credit which should be allowed to the Irrigation Department from the land revenue of the district may be approved.

4. The Settlement Officer's proposals as to the proportion of land revenue in jagir villages that is to be treated as khalsa, because due to canal irrigation, are, in the Financial Commissioner's opinion, suitable.

5. The Financial Commissioner also agrees with the Commissioner that the Native States concerned have no claim to any share of the income from nahri-parta.

6. As regards Mr. Dunnett's proposed rules for the assessment of areas to which canal irrigation may be extended or from which it may be withdrawn in future, the Financial Commissioner agrees in the criticisms contained in paragraphs 10 and 12 of Mr. Fagan's letter. Further, Mr. Diack is opposed to multiplying sets of rules for the assessment of nahri-parta, and as a suitable and typical set of rules has been worked out for Gurgaon in the correspondence ending with Financial Commissioner's letter No. 167, dated 18th June 1910 [Proceedings, Revenue and Agriculture (Revenue), Nos. 61, 62 and 63 for June 1910], the Financial Commissioner thinks we should try to adapt them for use in Ludhiana. The Settlement Officer's rules are drafted to meet cases of change in the size and position of outlets, and the Financial Commissioner thinks his objects will be attained if the following additions are made to the Gurgaon rules in Proceeding No. 63 above referred to. The additions will of course for the present be applicable to Ludhiana only :—

(i) Rule 6 should read—

If the sum resulting from the application of the rates detailed in rule 4 to the area defined in rule 5 is less than Rs. 50, or than $\frac{1}{8}$ th of the revenue of the village (whichever is less), no further action will be taken, *except as provided in rule 7-A*. But the field kanungo will note the result of the calculation in his attestation note in the jamabandi, and the tahsildar or naib-tahsildar who attests the jamabandi should check the calculation, and should state in his attestation note that he has done so.

(ii) Between rules 7 and 8 insert rule 7-A—

"Even if the above sum is less than Rs. 50, the Deputy Commissioner may direct the patwari to prepare a list in the form prescribed in rule 7, if in consequence of the position of an outlet having been altered, the Deputy Commissioner is of opinion that an appreciable alteration has occurred in the area benefited by canal irrigation, necessitating the transfer of the nahri-parta from one set of fields to another."

(iii) Add after rule 11—

"12. If a reduction allowed under rule 9 is due to an outlet having been closed, then the reduction shall be allowed with retrospective effect from the season of closure."

APPENDIX E.

7. The Financial Commissioner agrees with the Commissioner and Settlement Officer that separate zones for occupiers' rate are not required, and that no progress can be made at present with the scheme for having contracts for water-rates.

No. 6773, dated Jullundur, the 15th-18th December 1911.

From—P. J. FAGAN, Esq., I.C.S., Commissioner, Jullundur Division,

To—The Junior Secretary to the Financial Commissioner, Punjab:

WITH reference to your No. 6879, dated the 21st December 1910, to my address, and subsequent reminder, No. 748-R., dated the 5th September 1911, I have the honour to submit a copy of Settlement Officer, Ludhiana's, No. 551, dated the 9th November 1911, with enclosure. The letter contains his proposals relative to the nahri-parta assessment of canal-irrigated lands in the Ludhiana District.

2. In framing the fixed assessments which have been announced, the nahri and chahi-nahri wet rates sanctioned in the orders passed on the assessment reports have been used, and it therefore becomes necessary to specify how much of those assessments should be considered to be due to canal irrigation; in other words, to frame rates for the calculation of the nahri-parta demand. The specification is required mainly for two purposes—(1) in order to allow of the nahri-parta demand being adjusted from time to time to changes in irrigation in accordance with the principles which have been approved for the assessment of canal-irrigated lands; and (2) in order to afford indirect credit to the Irrigation Department for the increment of land revenue due to the existence of the Sirhind Canal.

3. Dealing first with the question of the pitch of the nahri-parta rate or rates, I quite concur with Mr. Dunnett in thinking that the basis of calculation should be a comparison of the rates sanctioned for khalis-nahri and for dakar-rausli lands, respectively. The lighter and more sandy bhur soil is not so adapted as dakar or rausli for canal irrigation, nor susceptible of so much benefit from its application. As regards lands classed as chahi-nahri, their assessable value is not increased, at all events to any material extent, by the use of canal water.

4. I remark that in the case of the Upper Dhaia Circle of Ludhiana, the Settlement Officer has, in making the comparison with the khalis-nahri rate, gone considerably above the sanctioned dakar-rausli rate on the ground that the latter rate was kept low for special reasons. It appears from paragraph 18 of the Financial Commissioner's review of the Ludhiana Tahsil Assessment Report that the rate would have been raised by 4 annas had it not been considered desirable to keep the total enhancement of assessment down to 34 per cent. So far, Mr. Dunnett's argument is sound. On the other hand, it appears from the table in paragraph 49 of the assessment report that the khalis-nahri and dakar-rausli rates are below the calculated half-net assets in roughly equal proportion, so that if the dakar-rausli rate is to be raised by four annas for purposes of the comparison with the khalis-nahri rate, the latter should be raised by at least the same amount, with the result that the difference between them would be still 10, and not 6, annas. In comparing, however, the nahri-parta rates to be adopted for the Jagraon and Ludhiana Tahsils, respectively, it must be borne in mind that in the latter irrigation is entirely from kharif channels and confined to the kharif harvest, and this, I think, points pretty decisively to the desirability of keeping the Ludhiana rate below that of Jagraon. For the latter 8 annas is, I think, suitable, so that, in my opinion, 6 annas may be adopted for the Ludhiana Dhaia Circles. I support Mr. Dunnett's other proposals relative to the pitch of the nahri-parta rates.

5. His calculation of the sum due as an indirect credit to the Irrigation Department out of the fixed assessment as announced may be accepted, though on the basis of the sanctioned assessment rates, the estimate for the Ludhiana Dhaia Circles is theoretically somewhat below the mark.

6. In view of the orders quoted in paragraph 4 of the Settlement Officer's note, it is quite clear that assignees are not entitled to any share of the nahri-parta assessed on lands included within their grants. In conversation

APPENDIX E.

with the Settlement Officer, I have ascertained that Hatur should not have been included in the statement given in paragraph 4 of his note. The grant in that estate is not a jagir, but a favourable assessment.

7. I see no reason whatever for surrendering to the Native States concerned the nahri-parta assessed on lands irrigated from their rajbahas. Any claim to it on their part would be obviously quite unsustainable.

8. In paragraph 6 of his note, Mr. Dunnett has dealt fully with the subject of future increases and decreases of nahri-parta. The correspondence in the analogous case in Gurgaon is contained in Punjab Government Proceedings, Revenue and Agriculture—Revenue, for June 1910, Nos. 53-63. I also invite reference to paragraph 20 of the Settlement Commissioner's review of the Jagraon Tahsil Assessment Report. I have discussed the subject at some length with the Settlement Officer. He is opposed to the adoption of the Gurgaon system of a quadrennial change of soil classification, and proposes to adopt one in which alterations of assessment shall be confined to cases of change in irrigated area due to alterations in the situation or size of outlets. The reasons which he advances in support of his proposal are, I consider, sound, more particularly the consideration that variations in canal-irrigated areas on the Sirhind Canal are due far more largely to variations in the demand than to variations in the supply for water. The Moga system will, I anticipate, be simpler in actual practice than that sanctioned for Gurgaon, while it has the merit of providing immediate relief in case of the closure of outlets. On the other hand, a possible defect in it is that Government would be precluded from assessing revenue on extensions of irrigation due to a materially improved supply from existing outlets or a materially improved duty from the volume of water provided by them at present. It appears, however, that such extensions are not likely to be of much, if any, consequence, at all events in the majority of villages, so that the above consideration may, I think, be safely neglected. Having regard to the circumstances of the Sirhind Canal, the system proposed by Mr. Dunnett will, I think, afford adequate relief in cases where canal irrigation decreases. I recommend it for adoption.

9. I add some remarks on the draft rules appended to the Settlement Officer's note. They deal with four cases in which alterations in assessment would be made under the system advocated by him :—

- (1) Closing of an existing outlet.
- (2) Opening of a new outlet.
- (3) Alteration in the position of an outlet, provided that there is an appreciable change in area irrigated.
- (4) Alteration in the size of an outlet.

In case (1), reduction of assessment will take effect from the kharif harvest succeeding the closure.

In case (2), increase of assessment will take place from the year following the year of the first jamabandi prepared not less than two years after the closure. It will be seen that in the cases most favourable to the assesses, the increase under this arrangement may be deferred for some five years. For instance, if a new outlet is opened in 1912 and the quadrennial attestation of the village concerned is due in 1913, the lands irrigated from the new outlet will not be assessed until 1917.

In case (3), lands which lose irrigation will be relieved from the nahri-parta assessment from the succeeding kharif as in case (1), while the imposition of assessment on newly-irrigated land will be deferred as in case (2). At first sight, such diversity may seem likely to lead to complications. They will, however, be sufficiently obviated, I think, by the proviso that alteration of assessment will be allowed only where there has been a material alteration in the irrigated area. Thus in cases where the change in the position of the outlet was so small as to cause no change in the situation of the area irrigated from it, no action would be taken under draft rule III.

APPENDIX E.

In case (4), decreases, as well as increases, in assessment would be deferred to the year following the year of the first jamabandi prepared not less than two years after the alteration. Here treatment is accorded to decreases different from that allowed in cases (1) and (3), but it is, I think, the only practicable course under the circumstances, though it introduces a certain element of complexity.

10. I have endeavoured to analyse the effect of draft rules I—V in the last paragraph. I am not in favour of the two-year proviso in rule V. It will, I think, unduly postpone the imposition of increases in certain cases, and its object seems to me to be on the whole sufficiently secured by the directions (reproduced from the Gurgaon rules) regarding the record of the conversion of a field from barani to nahri contained in draft rule VII (a). Under that, a barani field newly receiving canal water the year before the preparation of the jamabandi would not appear as nahri in that document, and its classification would, in fact, not be altered until the preparation of the next jamabandi four years later. Further, in cases dealt with under draft rule IV, the two-year proviso in rule V might possibly operate to prevent reductions of assessment for nearly five years. I would therefore omit the words "provided that that be not within two years" in rule V. Otherwise rules I to V may, I think, be accepted.

11. There is apparently less elasticity in draft rule VI than in Gurgaon rule 4, but as there is no provision for the variation of the nahri-parta from estate to estate, no course other than that adopted in the rule seems to be feasible. Rules VII and VIII follow Gurgaon rules 1 and 2, and may be accepted.

12. In his draft rule IX, Mr. Dunnett has reproduced No. 3 of the Gurgaon rules, but in doing so he has apparently lost sight of cases which will fall under his draft rule I or under the part of rule III relating to closure. It is obvious that in such cases the changes of soil classification must be detected and recorded not later than the rabi girdawari of the year in which the outlet is closed, and that the next jamabandi cannot be utilised in such cases as it will not then be in existence. Mr. Dunnett has suggested to me in conversation that the necessary entries should be made in red ink in the remarks column of the existing jamabandi, the total of the area affected being entered at the end. This, I am disposed to think, will be found to be a rather awkward procedure; it would be preferable, in my opinion, for the patwari to prepare in these cases a special statement of fields which had lost irrigation and the nahri-parta assessment of which should in consequence be taken off. I suggest that rule IX be drafted by the Settlement Officer with reference to the above remarks.

13. Rule X is again a reproduction of No. 5 of the Gurgaon rules. Under the system proposed by Mr. Dunnett and analysed in paragraph 9 above, it is, I think, unnecessary. It is obviously required in a system where every permanent change in the canal-irrigated area must be recorded and considered for the purposes of alteration of the nahri parta assessment, but not so in a system such as that now proposed under which only such changes will be dealt with as are caused by alterations in outlets, and not even all of them. Under such a system the total canal-irrigated area of the estate at any time does not provide sufficient material for calculating the amount of the revised nahri-parta assessment. Rule X may therefore, I think, be omitted.

14. The redrafting of rule IX suggested in paragraph 12 will probably necessitate changes in rule XI in order to provide for cases which may fall under draft rule I and the closure part of rule III. Rule XII can probably stand. Rules XIII-XV follow the Gurgaon rules 9-11, and may be accepted.

15. I concur in the Settlement Officer's opinion that separate zones for occupiers' rates are not required, and that the question of contracts for such rates may be dropped for the present.

16. As it is necessary to obtain orders as soon as possible on the main question of the system to be adopted in dealing with future increases and decreases of nahri-parta, I have thought it best to submit this reference without first requesting the Settlement Officer to revise the draft rules with reference to my criticisms in paragraphs 10-14.

No. 681, dated Ludhiana, the 9th November 1911.

From—J. M. DONNETT, Esq., I.C.S., Settlement Officer, Ludhiana,

To—The Commissioner, Jullundur Division.

I HAVE the honour to forward a note on various matters concerned with the assessment of canal-irrigated lands, along with a draft of rules for increases and decreases of the nahri-parta, and to ask for orders.

Note on certain matters concerned with the assessment of canal-irrigated lands and with occupiers' rates.

1. The points on which reports are required are as follows :—

A.—*The nahri-parta*—

(a) Its pitch.

(b) Credit to the Irrigation Department } (paragraph 21 of Settlement Commissioner's review and paragraph 11 of Financial Commissioner's orders on the Fatehabad Tahsil Assessment Report).

(c) Share of assignees

(d) Share of Native States

(e) Future increase or decrease (paragraph 6 of Financial Commissioner's orders on the Jagraon Assessment Report and paragraph 20 of Settlement Commissioner's review thereon).

B.—*Occupiers' rates*—

(a) Zones (paragraph 7 of Senior Secretary to the Financial Commissioner's No. 180, dated 23rd March 1910, and paragraph 20 of Settlement Commissioner's review of the Jagraon Assessment Report).

(b) Contract system [paragraph 4 of Chief Secretary to Government, Punjab's, No. 542-S. (Revenue), dated 10th June 1910, to the Secretary to the Government of India].

Orders are required on the first five.

I propose to deal with all these questions in one note.

2. *The pitch of the nahri-parta*.—The following statement shows, for all circles in which there is canal irrigation, the soil-rates which have been sanctioned on the assessment reports :—

1	2	3	4	5	6	7	8
Circle.	All-round nahri rate.	All-round barani rate.	Khalik-nahri rate.	Ran-til rate.	Difference between 2 and 3.	Difference between 4 and 5.	REMARKS.
	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	
Jagraon { Upper Dhina ...	2 14 1	1 13 7	2 8 0	2 0 0	1 0 6	0 8 0	
... { Lower Dhina ...	2 11 3	1 5 0	2 4 0	1 12 0	1 6 3	0 8 0	
Ludhiana { Upper Dhina ...	2 15 2	1 11 5	2 8 0	1 14 0	1 3 9	0 10 0	
... { Lower Dhina ...	2 12 0	1 2 2	2 12 0	1 4 0	1 9 10	1 8 0	
... { Powadh ...	2 13 0	1 14 3	2 8 0	2 0 0	0 15 0	0 8 0	
... { Jangal ...	1 8 5	0 15 3	1 0 0	1 0 0	0 9 2	0 0 0	

APPENDIX E.

In the two Lower Dhaia Circles only three villages receive a little canal irrigation, and they are practically Upper Dhaia villages. For these circles the Upper Dhaia partas will be appropriate, and we need not consider them separately. In the Powadh only three villages receive irrigation. All are jagir, and the irrigation, which is received in both harvests, is from foreign rajbahas. The Jagraon parta will be suitable. In these three circles extension of canal irrigation is very improbable.

A comparison of the all-round nahri, and all-round barani, rates is not a fair way of arriving at the nahri-parta. In the first place, almost all the nahri soils were originally dakar or rausli. Bhur is usually found in bands somewhat above the level of the surrounding country, and is rarely irrigated. For instance, in the Jangal Circle, since the introduction of canal irrigation, the recorded bhur area has fallen only from 6,790 acres to 5,997 acres, while dakar and rausli have fallen from 52,611 acres to 41,248 acres; i.e., over 11,000 acres of old dakar and rausli have been irrigated against less than 800 acres of bhur.

In the second place, the transfer of land from the nahri-khalis to the nahri-niai class is due to the efforts of the people, not to increased irrigation, and the increase of naii-nahri means a decrease of naii-chahi. I think we should arrive at the nahri-parta by comparing the khalis-nahri soil-rates with the dakar-rausli rates, as is done in column 7 of the above statement. Apparently this was the method used by Mr. Diack in paragraph 16 of the Settlement Commissioner's review of the Jagraon Assessment Report.

In Jagraon 16,128 acres receive perennial irrigation and 3,319 acres kharif irrigation. The difference between the khalis-nahri and the dakar-rausli soil-rates is 8 annas per acre. This should be the nahri-parta in all villages.

In the Ludhiana Upper Dhaia all irrigation is in kharif only. The difference between the khalis-nahri and the dakar-rausli rates is 16 annas per acre. But the latter rate was kept low for reasons unconnected with the value of the produce. The Commissioner proposed to raise the dakar-rausli rate by 4 annas to Rs. 2-2-0 per acre, and the Financial Commissioner (paragraph 18 of his review) considered that the increase would be justifiable if it were necessary. A dakar-rausli rate of Rs. 2-2-0 would give a nahri-parta of 6 annas per acre, which I propose as the rate for the Lower Dhaia and Upper Dhaia Circles of this tahsil.

In the Jangal the nahri-khalis and dakar-rausli rates are both low. The Commissioner would have raised both, still keeping a difference of 6 annas. On the actual assessment, the nahri-parta comes to 6 annas per acre.

3. *Credit of the nahri-parta to the Irrigation Department.*—The disposal of the nahri-parta among Government accounts is probably *res judicata*. Assuming that this is so, I have only to report the total value of the nahri-parta.

All chahi-nahri has been assessed as chahi-niai. Canal water is used only to supplement or partly replace well water on such lands, and no portion of the enhanced demand can therefore be regarded as due to the introduction of canal water into the chahi chaks. I exclude chahi-nahri from the calculation of the gross nahri-parta, which is as follows:—

1	2	3	4
Circle.	Recorded nahri area in acres	Proposed nahri-parta per acre.	Value of nahri-parta.
Jagraon Dhaia Circles	19,569	Rs. A. P. 0 8 0	Rs. A. P. 9,784 8 0
Ludhiana Dhaia Circles	7,458	0 6 0	2,780 12 0
Powadh	617	0 8 0	918 8 0
Jangal	13,839	0 6 0	5,189 10 0
TOTAL	41,483	...	81,079 6 0

APPENDIX E.

4. *Share of assignees.*—The following statement shows all jagirs in which the revenue now assessed includes an item by way of nahri-parta. The previous demand was in all cases assessed on the land in its barani aspect alone:—

Name of jagir.				REVENUE DEMAND ASSIGNED.		Amount of nahri-parta at proposed rates.	Increase per cent. in jagir, less nahri-parta.	REMARKS.
				By old assessment.	By new assessment.			
Ludhiana	Malaudh	...	...	Rs. 46,262	Rs. 69,961	Rs. 2,774	46	
	Pakhoki	...	..	23,168	34,533	1,368	43½	
	Der Khurd	...	...	18,974	29,293	1,069	49	
	Hans	...	...	2,454	3,232	55	29½	
	Bagrian	...	...	4,697	5,034	218	10½	
	Bhojwalli	...	...	1,843	2,400	74	26	
	Lalton	...	...	4,768	5,630	24	17	
Jagraon	Bhamipura	...	...	391	650	15	66½	
	Mallah	...	...	69	160	10	90½	
	Hatur	...	...	35	49	2	34	
	Aligarh	...	...	880	1,400	51	62½	
	Toghal	...	...	707	1,350	25	66	
TOTAL				1,04,413	1,54,578	5,650	42½	

In all these cases, excluding Mallah and Hatur, the assignment is either the whole revenue of specified villages or a fixed share of it. The total nahri area in jagir villages is 16,301 acres (1,634 acres in Jagraon and 14,667 in Ludhiana). The jagir villages include the whole of the Jangal Circles. None of these jagirdars assisted in any way in the introduction of canal irrigation, and under the orders given in Revenue Secretary to Government of India's No. 144-226-6, dated 11th February 1909, on the Mananwala Bar case, Government should appropriate the whole of the nahri-parta, or Rs. 5,680 leaving the rest of the revenue to the assignees. The result of reassessment will still be a large increase in the receipts of the jagirdars.

5. *Share of Native States.*—In the Jagraon Tahsil all irrigation is from British rajbahas, but in the Ludhiana Tahsil one village of the main block of the tahsil and six outlying villages receive irrigation from foreign rajbahas. The working agreement is that all rajbahas shall irrigate indifferently all villages in their track, to whatever jurisdiction they may belong; all Government profits from the use of the water go to the State owning the rajbahas.

Of the 25,152 acres canal-irrigated in the Ludhiana Tahsil, 2,707 acres (2,357 acres nahri, 350 acres chahi-nahri) are irrigated from foreign rajbahas. Four hundred and sixty-one acres (12 acres chahi-nahri) are irrigated from rajbahas owned by the Patiala State, 922 acres (333 acres chahi-nahri) from the Nabha rajbahas and 1,524 acres from the Jind rajbahas.

The nahri-parta on these foreign-irrigated lands at the rates proposed is Rs. 961 (Patiala Rs. 172-8-0; Nabha Rs. 292 and Jind 486-8-0).

On the other hand, very considerable areas in Native States are irrigated from our branches. From the Barnala Assessment Report I find that in that tahsil, which lies all round our Jangal Circle, Ludhiana branches irrigate 25,932 acres, and in Bhatinda Tahsil the area irrigated from British branches is as much as 62,967 acres.

APPENDIX E.

When the water-rates on the Sirhind Canal were raised in 1904, the Native States promptly followed suit and adopted the same scale. The Financial Commissioner considered that the new water-rates contained a charge, by way of land revenue. Partly on this ground, and partly in the belief that to assess, the landlords, increased profits, due to canal irrigation, "by a higher land revenue rate on lands classed as nahri, would be contrary to the policy likely to be adopted by the British Government when dealing with the revenue and canal assessments in the British districts irrigating from the same canal system", the Patiala Darbar, at the recent settlement, assessed canal-irrigated lands in their unirrigated aspect. The Government of India, however, repudiated the view, that the Sirhind scale of water-rates contained any charge by way of land revenue. I believe that there is no nahri-parta in Nabha or Jind.

The result is that the British treasury receives from the State-owned lands irrigated from British branches only water-rates, and these at the same pitch as the rates collected by the States for their irrigation on British-owned lands. In these circumstances, the Patiala Darbar at least has no equitable claim to the nahri-parta on the Ludhiana lands irrigated from the Patiala branches.

If the nahri-parta on the Nabha and Jind irrigated lands is surrendered to these darbars, it should be on the understanding that any reassessment in these States will provide for land revenue payments in the British treasury from State land watered by British rajbahs. The revenue of all lands irrigated from foreign rajbahs is assigned.

6. *Future increases and decreases of the nahri-parta.*—At measurement, 167 villages received canal irrigation. Since then, one (Pohir), has lost its mogha, and one has received, or is about to receive, canal water. The realignment of the upper reaches of the Manoke rajbaha is under consideration, and an alteration will have to be effected in the Raekot rajbaha. Rules to cover such cases are required.

I have considered three methods of assessment—

- (a) The method sanctioned for Gurgaon, *i.e.*, by soil classification pure and simple, on the quadronial jamabandis.
- (b) The fixed chak, plus fluctuating water-advantage-rate (paragraph 4 of Mr. Douie's orders on the Gurgaon case).
- (c) The mogha system suggested in paragraph 45 of my Jagraon report. Comments on this system will be found in paragraph 20 of the Settlement Commissioner's review of the Jagraon report.

There are several objections to the introduction in this district of the Gurgaon system—

- (1) The capacity is unnecessarily wide. In the canal tracts, usually every village of each patwari's circle receives canal irrigation. Under the Gurgaon system each village has to be enquired into every time its jamabandi is reattested; *i.e.*, the whole nahri tract has to be re-examined once every four years.
- (2) Soil classification is not easily inspected or supervised in the district. The method is practically a compilation from the khasra girdawari, every field with nahri entries for two years against it being taken as nahri. But the district staff is not very good at checking such entries in the khasra girdawari. Too much is left to the patwari.
- (3) It has been recognised that variations in canal-irrigated areas in this district are almost entirely due to variations in the demand for water. In a cycle of years of good rainfall, the nahri areas would certainly fall much below the nahri areas of settlement, and there is no call in theory, practice or equity to take off the nahri-parta in the very years when profits have risen.

The Gurgaon system may be suitable to districts where fluctuations in irrigated area are mostly due to variations of the water-supply. It is not necessarily suitable to a district where the supply is sure and the demand varies. The only variations we need recognize are the withdrawal or extension of facilities.

APPENDIX E.

- (4). It has always been our endeavour to encourage the zamindar to spread canal water over a wider area. A method of pure soil classification tends in the other direction.

The method which Mr. Douie would have preferred for Gurgaon avoids these objections to a great extent, and has the prime merit of limiting the enquiry to what the district staff can easily overtake. But, unfortunately, the Government of India orders, I think, preclude us from adding to a system of fixed assessments on nahri lands a system of fluctuating land revenue rates on extensions. I presume that inside his "chaks" Mr. Douie would have reduced the assessment only if facilities were withdrawn and would not, inside them, have gone on cropping alone.

I have discussed the proposed mogha system of assessment with the Executive Engineer. He agrees that canal irrigation is now given under very stable conditions, but he does not agree with me in the belief that the great majority of moghas now draw as much water as they are ever likely to draw. He admits, however, that in individual villages, so long as the outlets remain unaltered, variations in the irrigated area due to variations in the supply are not likely to exceed 100 aaras. We are therefore agreed that the proposed mogha system would not go further than the Gurgaon 50-rupee rule in the way of disregarding increases of nahri due to the bigger volume of water poured through the present moghas. Thus under either system assessable increases of the nahri area, during the continuance of the present outlets, will be practically due to more economical use of the water by the zamindars. I think we might, both for our own convenience and to avoid harassment of the people, and also to encourage better cultivation, overlook these increases. I make no appeal to leniency because the canal tracts are still very lightly assessed, and can easily pay considerable increases, but I would confine enquiries within narrow limits and would increase the demand only when we have obviously increased the facilities.

I have reported above a nahri-parta of 8 annas per acre for the whole of the Jagraon Tahsil and the Ludhiana Powadh, and of 6 annas for the rest of the Ludhiana Tahsil. I propose to apply this parta to future increases of canal-irrigated areas. I am not sure that in theory we need apply these rates in full to decreases in recorded nahri. Of the 75 canal-irrigated villages in Jagraon, 73 villages have ranked all nahri with barani soils in the bachh, but in the Ludhiana Tahsil out of 110 villages 62 villages have put a higher rate on nahri-khalis than on rausli. To avoid the appearance of injustice by taxing increases, and not remitting on decreases, I propose to apply the same partas to decreases and increases, whatever the method of bachh may have been.

If it is decided by the Financial Commissioner that the Gurgaon system is suitable for Ludhiana, the only alteration required in the Gurgaon rules will be in rule 4 by the substitution for (a) of the words "In villages of the Jagraon Tahsil or the Powadh Circle of the Ludhiana Tahsil, 8 annas per acre", and for (b) the words "In all other villages, 6 annas per acre".

7. *Zones of occupiers' rates.*—There is much less difference in canal-irrigated villages than I originally thought. The weakest canal-irrigated villages are in the south of the Jangal, and one or two in the south of the Jagraon Tahsil. But these are precisely the most lightly-assessed villages, and in them canal irrigation is ample and secure. There are no villages where insecurity or scarcity of canal water leads to markedly inferior cropping, and the present occupiers' rates are nowhere too heavy. We have very few tail villages, and there is no irrigation of wretched soils. I do not propose separate zones of occupiers' rates.

8. *Contracts of occupiers' rates.*—I have discussed this system with the people freely during village inspection. They understand the system, but no one will look at it because (a) it is now; (b) it is a gamble; and (c) they dislike an annual bachh, which in any case they could not do themselves. The malba is worry enough. There is no intention of forcing contracts on the people, and as they will not accept them, I make no proposals.

J. M. DUNNETT,

The 4th September 1911.

Settlement Officer, Ludhiana.

APPENDIX E.

PROPOSED RULES FOR THE ASSESSMENT OF AREAS TO WHICH CANAL
IRRIGATION MAY IN FUTURE BE EXTENDED, OR FROM WHICH IT
MAY BE WITHDRAWN.

ASSESSMENT RULES.

I.—When an outlet is closed, the nahri-parta on all land irrigated from it and recorded in the settlement record, or assessed since settlement as nahri-niai or nahri-khalis, shall be remitted from the succeeding kharif. No remission shall be given on lands recorded as chahi-nahri.

II.—When a new outlet is opened, the nahri-parta shall be imposed on all consequent increases of nahri land (including chahi-nahri) recorded at the times prescribed in rule V.

III.—When the position of an existing outlet is so altered as to cause, in the opinion of the Collector, an appreciable alteration of the area benefited by canal irrigation, the alteration shall be treated as the closing of an old, and the opening of a new, outlet.

IV.—When the size of an existing outlet is altered, the nahri-parta shall be imposed on all increases, and remitted on all decreases, of nahri land recorded at the times prescribed in rule V.

Pending the reclassification of soils, the existing assessment will remain unaltered.

Note.—This rule applies also to a change in the shares on which two or more villages enjoy irrigation from a joint outlet.

V.—When a new outlet has been opened or an existing outlet altered in size or position, at the first succeeding attestation of the jamabandi a fresh soil classification of fields irrigated from the new mogha shall be made. The soil classification may be revised at the attestation of the next succeeding jamabandi if it appears to the Collector that irrigation was not fully established at the time of classification.

VI.—The nahri-parta to be applied to increases or decreases of recorded nahri area shall be one of the following rates :—

- (a) In the whole of the Jagraon Tahsil and in the Powadh Circle of Ludhiana Tahsil, 8 annas per acre.
- (b) In all other circles, 6 annas per acre.

PROCEDURE RULES.

VII.—In cases mentioned in rule 1, the patwari, without waiting for the preparation of the next jamabandi, shall at once proceed to prepare, from the settlement record or the jamabandi following the last reassessment of nahri-parta, a list of fields converted from nahri to barani in the form given in rule XI. All fields previously shown as nahri (nai or khalis) and irrigated from the outlet now closed will be returned as barani. In other cases, in making the changes of soil classification prescribed by the note regarding column 7 of the jamabandi form (paragraph 22 of standing order No. 23), no field or part of a field—

- (a) shall be converted from barani to nahri unless the khasra girda wari shows it to have been irrigated in two out of the four years ending with that to which the jamabandi relates ;
- (b) shall be converted from nahri to barani unless it has not been irrigated in the year to which the jamabandi relates, and likewise in the two preceding years.

VIII.—If only part of a field has been converted from barani to nahri or *vice versa*, no change of classification shall take place if the area affected is less than one pacca bigha.

APPENDIX E.

IX.—The new entry of nahri in place of barani or barani in place of nahri shall be made by the patwari in red ink. The field kanungo shall see that the changes made are in accordance with rule VII, and shall sign the new entry. He shall further, by an examination of the khasra girdawari, satisfy himself that the change of entry has been made by the patwari wherever such a change was required. He shall carefully check the totals of nahri and barani entered at the end of the jamabandi, and shall attest them with his signature. In his note on changes in soil entries attached to the jamabandi (see instructions appended to the jamabandi form in paragraph 22 of standing order No. 23) he shall state exactly what he has done to ensure correct entries. In attesting jamabandis, tahsildars and naib-tahsildars must pay special attention to these new soil entries.

X.—If the additional nahri assessment under these rules has already been imposed on, or a reduction made in, a village at a previous attestation, the area to which the rate referred to in rule VI will be applied will be the excess or reduction of area since the last imposition or reduction of nahri assessment. If no previous assessment has been imposed or reduced, the area will be the excess or reduction of area since last settlement.

XI.—On completion of the soil classification, the patwari will prepare a list in the following form and forward it to the field kanungo. After it has been checked and signed by the latter and by the Revenue Officer of the circle, it will be forwarded to the tahsildar unless he is himself the Revenue Officer of the circle :—

List of fields converted from barani to nahri and vice versa, with additional nahri assessment.

[illegible]

NOTES.—Columns 7 and 9.—If part of a field is affected, the word "min" should be added. If a whole holding is affected, no detail of field numbers is required; the words "salim khata" are sufficient.

Columns 8 and 10 in total of the village acres should also be noted in red ink.

Column 11.—L'or ratio acc rule VI.

Columns 12, 13, 16 and 17.—Detail of mass, if any, should be noted in red ink.

XII.—On receipt of the detailed statement, the tahsildar shall have an abstract for the tahsil prepared, in duplicate by the wasil-baki-nawis in the form below. A separate abstract will be prepared for each Canal Division

APPENDIX E.

concerned. After signature, a copy of the abstract, with the detailed statements, will be forwarded by the tahsildar to the Collector so as to reach his office not later than 31st July : -

Abstract showing nahri assessment payable on account of extensions of canal irrigation or remissible on account of reductions of the same in

Tahsil , District for the year 19 .

1	2	3	4	5	6	7	8	9	10	11	12	13	
Serial No.	Topographical No.	Name of village.	ADDITIONAL NAHRI ASSESSMENT TO BE IMPOSED.			NAHRI ASSESS- MENT TO BE REDUCED.		AMOUNT OF LAND REVENUE PAYABLE BY THE VILLAGE FROM KHARIF 19 .					REMARKS.
			Area in acres converted from barani to nahri.	Rate.	Land revenue.	Area in acres converted from nahri to barani.	Land revenue at rate given in column 5.	Land revenue.		Cases.	TOTAL.		
								Khalasa.	Mafi.				

XIII.—After the statements have been checked in his office, the Collector shall report the amount of the assessment to be imposed and to be reduced, through the Commissioner, for the sanction of the Financial Commissioner, and shall inform the *Executive Engineer of the proposal made, sending him at the same time the abstracts for information and return.* On receipt of sanction, he will return the detailed statements to the Tahsildar, ordering him to have the addition to, or the reduction from, the assessment incorporated in the kharif bachh.

XIV.—In incorporating the changes due to addition on reduction of assessment in the bachh, the patwari shall, *whether the assessment on nahri and barani is distributed at an all-round rate or by differential soil rates, impose or reduce the nahri rate on or from the holdings affected, taking the details from the statement in rule 7.*

XV.—Field kanungos and revenue officers must carefully check the patwaris' bachh work, and see that the above orders are correctly carried out.

J. M. DUNNETT,

The 4th November 1911.

Settlement Officer, Ludhiana.

NOTES (not to be reproduced with rules.)

Rule I.—The new assessment does not impose any additional assessment on chahi-nahri in consideration of the canal irrigation received. In this case no remission is required.

Rule II.—Chahi-nahri is included, as it is advisable to discourage the introduction of canal water into the chahi chaks.

Rule III.—“Appreciable alteration” is meant to obviate any enquiry in cases where the outlet has been only slightly shifted. Occasionally such changes involve no realignment of water-courses.

Rule IV.—The existing assessment is still light, and it is not necessary to reduce the old assessment till the new conditions are established.

APPENDIX E.

Rule V.—The last sentence is meant to cover cases where, either from a desire to avoid additional assessment or from other causes, the water-course system from the new outlet has not been fully constructed by the time of soil classification. Such a case actually occurred in Mauza Raisar (Jangal).

J. M. DUNNETT,

Settlement Officer, Ludhiana.

No. 296, dated Lahore, the 11th April 1912.

From—H. S. WILLIAMSON, Esq., Junior Secretary to the Financial Commissioners, Punjab,
To—The Revenue Secretary to Government, Punjab.

IN continuation of paragraph 6 of my letter No. 264, dated 27th March 1912, I am directed to forward a copy of the letters noted marginally, and to say the Financial Commissioner regrets having omitted to notice in the letter above quoted that rule 4 of the Gurgaon rules requires modification to suit Ludhiana. I am to say that if Mr. Diack's proposals are approved, then for (a) and (b) of the Gurgaon rules should be substituted :—

“(a) In Jagraon, 8 annas per acre.

“(b) In the rest of the Ludhiana District, 6 annas per acre”.

Endorsement by the Financial Commissioner on No. 264, dated the 27th March 1912, to the address of the Punjab Government.

No. 2582, dated Lahore, the 27th March 1912.

COPY forwarded to P. J. FAGAN, Esquire, Commissioner of the Jullundur Division, for information, with the request that if he sees any objection to the adoption of the draft rules now proposed, he will represent it in order that it may be brought to the notice of Government.

No. 1732, dated Jullundur, the 1st April 1912.

From—P. J. FAGAN, Esq., I.C.S., Commissioner, Jullundur Division,
To—The Junior Secretary to the Financial Commissioners, Punjab.

WITH reference to your endorsement No. 2582, dated 27th March 1912, I have the honour to point out that the only point which it seems necessary to bring to notice is that the rates prescribed in rule 4 of the Gurgaon rules will not apply in the case of Ludhiana. The rates proposed by the Settlement Officer, and recommended by the Financial Commissioner, are 8 annas per acre for Tahsil Jagraon and 6 annas for the rest of the district. These rates might, I think, be applied also to estates to which canal irrigation may be extended hereafter, though there are not likely to be many of these.

Endorsement by the Punjab Government on No. 264 and 296, dated the 27th March and 11th April 1912, respectively from the Financial Commissioner, and enclosures.

No. 92 (Rev. & Agri.—Revenue), dated Lahore, the 8th May 1912.

COPY forwarded to the Chief Engineer, Irrigation Works, Punjab, with reference to the correspondence ending with the endorsement from this office, No. 2737-S., dated the 1st October 1910, for favour of remarks.

APPENDIX E.

No. 289, dated Ludhiana, the 1st February 1919.

From—T. M. BOSCOCK, Esq., Executive Engineer, Ludhiana Division, Sirhind Canal,
To—E. R. FOX, Esq., Superintending Engineer, Sirhind Canal Circle.

The 30th-class Rates.

WITH reference to your endorsement No. 4694, dated 23rd September 1918, I have the honour to say that as the rabi sowings this year are exceptionally heavy, there is every likelihood that a large area will remain "kor" and be chargeable at 5th-class rates.

The total sowings for this division will probably be about 120,000 acres, of which hardly half has received first waterings so far. The present rain, if followed by other sowings in February and March, which is very possible, may mean that 60,000 acres will remain "kor". If there is no more rain, then probably 30,000 acres will be "kor".

Thus an amount varying between Rs. 60,000 \times Rs. 3-12-0 and Rs. 30,000 \times Rs. 3-12-0 will be lost to Government, i.e., between Rs. 2,36,000 and Rs. 1,18,000.

2. Now this remission for "rauni" waterings must obviously be meant to encourage the use of water when it can best be spared, i.e., when there is a slack demand; but during the present famine season there was no such period when water might be considered to be "cheap". There was absolutely no rain in September, and all rauni was done at a time of extremely keen demand.

In support of this, it may be mentioned that it was found, in trying cases for "war shikni", that zamindars were prepared to bribe the subordinate staff at the rate of Rs. 5 per acre in order to secure a "rauni" watering; this, be it remembered, in addition to the lawful charge of Re. 1-8-0 leviable by Government. It should also be mentioned that breaches caused by zamindars cutting channels this year have been very frequent, and that the penalties of double rates imposable by law have not acted as deterrents. This alone is eloquent of the value of water this year. It is also noteworthy in this connection that the cultivators on the Sirhind Canal are great "rain gamblers"; i.e., more so than on any other canal, for the reason that on the light sandy soils of the Sirhind Canal tracts, a few light showers received at the right times are sufficient for maturing the crops. This means that canal water is practically never taken, except at times when it is absolutely necessary to the cultivators, and consequently extremely valuable. The argument is that Re. 1-8-0 per acre (5th-class rate) does not at all adequately represent the value of the water to the cultivators.

3. The following figures exemplify the great benefits derived from canal water this year, and the inadequate share of this benefit represented by the water-rates:—

Principal crops.	Onturn per acre.	Value per acre.	Water-rate.
		Rs.	Rs. A. P.
Maize	35 maunds at Rs. 5 ...	175	5 4 0
	Straw	20	
Sugarcane	Sold as fodder at Rs. 250 per acre	250	12 0 0
Cotton	10 maunds at Rs. 18 ...	180	4 0 0
Wheat	12 maunds at Rs. 6-8-0 ...	78	5 4 0
	Straw 12 maunds at Rs. 2 ...	24	
Barley	15 maunds at Rs. 5-8-0 ...	82	4 0 0
	Straw 10 maunds at Re. 1-8-0	15	
Gram	12 maunds at Rs. 5 ...	60	3 4 0
	Bhusa 6 maunds at Rs. 1 ...	6	

Thus it will be seen that the full water-rate is a mere trifle to the cultivators under present prices of produce, and the 5th-class rate of Re. 1-8-0 is absurdly low in view of benefits received.

APPENDIX E.

EXTRACT FROM THE REPORT OF THE INDIAN IRRIGATION COMMISSION,
1901-03, PART I—GENERAL.

97. When the charge for irrigation takes the form of an enhancement of land revenue, there is a consequent increase in the proceeds of local cesses which deserves notice. This increase is not credited to the works because the money is spent locally in providing improved roads, schools, dispensaries, etc., for the benefit of those who contribute it.....

162.It would be fairly safe to say that the capital cost of a permanent well in Northern India would be seldom more than Rs. 40 per acre irrigated. In South and Central India it would seldom average less than Rs. 100 per acre, except in the tracts where the semi-permanent well can be used, when the cost would run between Rs. 60 and Rs. 80 per acre.

164. The quantity of work which can be done on a well varies immensely with the season, the area to be irrigated, and the character of the crop. It is almost impossible therefore to arrive at any satisfactory estimate of the cost of irrigation from a well for such purposes, for instance, as comparison with the cost of irrigation from a canal. But there can of course be no manner of doubt that well irrigation is by far the more expensive process of the two, except perhaps when water lies so close to the surface that irrigation can be done by means of the lever. To arrive at even a tolerable estimate, the most elaborate and careful experiment is required. The only set of such experiments with which we are acquainted are those of Captain Clibborn published in his report on well irrigation in the United Provinces. Here, the irrigation of a crop of wheat, with the mean water-level at 30 feet, is shown at Rs. 7 per acre; and this is doubtless the lowest figure at which the charge can be fairly estimated. In Southern India the heavy waterings required largely increase the charge. Thus the irrigation of a crop of barley in the sandy soils of the Ahmedabad District is estimated to cost Rs. 22-8-0 per acre, and that of garden crops in the neighbourhood of Surat ranges from Rs. 30 to Rs. 60 per acre.

EXTRACT FROM THE REPORT OF THE INDIAN IRRIGATION COMMISSION,
1901-03, PART II—PROVINCIAL.

The Punjab....., there will remain 4,356,992 acres irrigated during the year from works, the capital cost of which has amounted to Rs. 9,20,75,977, or Rs. 21.1 per acre, which shows at what a low rate irrigation can be provided on the perennial canals of the Punjab. The working expenses during the year amounted to Rs. 43,01,651, or nearly Rs. 0.99 per acre. Interest charges and working expenses may therefore be taken together at Re. 1.83 per acre. The gross revenue during the year averaged Rs. 3.36 per acre, leaving Re. 1.53 per acre as clear profit to Government. The total value of the crops, excluding the areas assessed on Native States' branches, has been estimated at Rs. 12,05,00,000, or 23½ per cent. in excess of the whole capital cost of the works; the average value per acre being about Rs. 28, or eight times the amount taken as gross revenue. The value of the crops assessed on the Native States' branches amounted to nearly Rs. 72 lakhs. These figures give a very fair indication of the productive, protective and financial results which have been attained on major irrigation works in the Punjab.

32....In addition, many extensions would be possible into high and dry lands that cannot be commanded by the present canals, where high rates would be readily paid for the advantages of irrigation....

APPENDIX E.

EXTRACT FROM THE REPORT OF THE INDIAN IRRIGATION COMMISSION,
1901-03.

EVIDENCE.

Mr. S. Preston.

52. Q.—Can you supply us with any figures regarding the relative productiveness of irrigated and non-irrigated land? No; I have none at hand. The difficulty is, I think, that the outturn varies from field to field. Some Settlement Officers have made crop experiments and published the figures, but they are considered to be absolutely valueless owing to the difficulty of striking an average.

109. Q.—Has there been any withdrawal of irrigation and remission of the wet rate? No; the figures show that the area has increased enormously. I have records in which I pointed out that the nahri-parta ought to have been enhanced; we must have introduced new irrigation into a good many tracts, and the wet assessment has not been put on as it should have been.

124. Q.—You know sugarcane is an important crop in these parts? Yes.

125. Q.—The villagers practically pay their revenue from it? Yes. I know they do.

126. Q.—So important that it has been described by Colonel Otley as the sheet-anchor of the canal revenue? Yes; that was his opinion; now-a-days we would not so describe it.

127. Q.—I want to show its importance? Yes; it is very important; it is going on still increasing; with reference to that, some civil officers, as well as canal officers, thought it would be a good thing to restrict it in order to save water for fodder crops.

128. Q.—I understand that that policy has been disallowed? No; Sir Denis Fitzpatrick said sugarcane hampers us very much; the question of raising rates should be taken up; it was intended to raise rates in order to restrict it and set water free for rabi crops.

129. Q.—I understood it had been definitely disapproved? No; the matter is now before the Financial Commissioner.

130. Q.—The present rate for sugarcane is extremely low? Yes.

131. Q.—It would require an enormous increase in the rate to reduce the cultivation of sugarcane materially? Probably it would; I am very doubtful if any increase which is in the least likely to be sanctioned would materially affect the area.

145. Q.—Have you any knowledge of any attempts to restrict the use of canal water on well-irrigated lands? Yes; we tried our best to do that on the Bari Doab Canal; we used not to give water on well lands, and tried to keep wells working.

146. Q.—Did you succeed? No.

147. Q.—Why? In the first place, at that time there was a water-advantage-rate which was only charged to barani lands; as well lands had been assessed as chahi, we were not allowed to charge a water-advantage rate on such lands so that a man who took water on well land paid less than on barani land.

160. Q.—I think in the Punjab to some extent, and in the North-Western Provinces to a very great extent, the mistake was made of beginning with too low water-rates, and allowing landlords to acquire in the form of rent, a very large proportion of the profits of water? Yes.

161. Q.—And that practically, our attempts to recover a substantial share of that profit have failed? Yes; they have failed, I believe.

162. Q.—Recent policy in the Punjab canals has tended to impose full occupiers' rates so as to leave as far as possible no undue profits to the owners? Yes.

APPENDIX E.

163. Q.—The necessary leniency which you must use on first opening a canal is met by fixing full rates, and giving liberal remissions? Yes.

164. Q.—Does not the Local Government receive a share of the water-advantage-rate, and none of the occupiers' rate; and are not cesses levied on the former, but not on the latter? Yes.

165. Q.—Has not a water-advantage-rate been imposed where you think it would have been better to impose a higher occupiers' rate and no water-advantage-rate? I know it has been continually urged by Settlement Officers that if they did not impose the latter, they could get nothing out of the canal.

166. Q.—Within your knowledge, these two considerations have complicated the question? Yes.

167. Q.—In practice at present the Punjab Government has a much smaller interest in the extension and promotion of irrigation than the North-Western Provinces, the canals in the latter province having been provincialized, and not those in the Punjab.

168. Q.—You are an advocate of provincialising the canals? Yes; because I am a Punjabi, and I think the Punjab should get the benefit of their splendid property.

EXTRACT FROM THE REPORT OF THE INDIAN IRRIGATION COMMISSION,
1901—03—APPENDIX.

EVIDENCE.

Mr. J. Wilson.

2. . . . The importance of artificial irrigation varies inversely with the amount and certainty of the local rainfall. . . . Further to the south-west, as the rainfall decreases in amount and becomes more uncertain, wells and canals become more and more important until in the south-west of the Punjab no attempt is made to grow a crop unless it can be irrigated by a well or canal, or sown on land moistened by river-floods.

8. . . . On the lower part of the Sirhind and Western Jumna Canals on an average of years the produce of the land is increased by canal irrigation from about Rs. 5 to about Rs. 15, and in a year of drought from nil to Rs. 20. In the upper part of the Sirhind and Bari Doab Canals, where cultivation by means of wells and the local rainfall is possible, the value of the crops grown is increased by canal irrigation in a normal year from about Rs. 15 to about Rs. 30, and in a year of drought from about Rs. 10 to Rs. 40.

9. . . . In the lower portions of the Sirhind Canal, where the soil is light and the population scanty, Government realises about Rs. 2-8-0 per acre actually irrigated, and so far has not realised any owners' rate or enhancement of land revenue; but as the Fazilka Tahsil is now under reassessment, the land revenue is likely to be largely enhanced. The landowner used to realise from the tenant about 6 annas per acre under cultivation equal to about 8 annas per acre harvested. He now realises (besides the occupiers' rate which is paid by the tenant) one-fourth of the gross produce, or about Rs. 4 per acre, so that his profits have very greatly increased. In the upper part of the Sirhind and Bari Doab Canals also the rents paid by tenants to landlords on canal-irrigated lands have increased much more than in proportion to the payments made by them to Government. **I am strongly in favour of securing to the State, which has by the expenditure of its capital constructed these canals, a large share of these enormous profits made by landlords owing to the introduction of canal irrigation, and I, think, no opportunity should be lost of doing so, whether by enhancing the occupier's rates, enhancing the land revenue or imposing an owner's rate.**

APPENDIX E.

EXTRACT FROM THE REPORT OF THE INDIAN IRRIGATION COMMISSION,
1901-03—APPENDIX.

EVIDENCE.

Colonel S. L. Jacob.

22. . . . (2) The British Government to fix the rates to be charged as it thinks fit.

(These rates will be doubtless higher than on the Sirhind Canal, seeing the immense value of the water in such a rainless tract, and the great cost involved by this scheme, and the other schemes necessitated by this one.)

28. . . . The chief unirrigated and irrigable tract is the one which would have to be reached through the Jhind territory from the Butana branch, which must be enlarged. On no account, however, should this distributary be made until the Jhind Darbar consents to the condition that it should be wholly a British channel, and all the irrigation be looked after by British officials, and a consolidated rate be charged for the water, equal to the combined rates paid on British territory. . . .

32. . . . It is the waterings for the cane which so stand in the way of the developments imperiously needed. The combined rates for sugarcane should be raised from Rs. 9 per acre, as at present, to at least Rs. 18. . . .

40. It will hardly be disputed by any who have a thorough knowledge of the subject that the returns obtained for the water used for irrigation are exceedingly inadequate.

This is seen by the extraordinary enhancement in the value of the land when it becomes irrigable. That the value should be enhanced is intelligible enough, and quite right, but the value is not only doubled and trebled, but sometimes twenty-fold what it was before.

It is often stated that the condition of the peasantry on the new canals is very satisfactory. This is true, but it is the condition of the peasantry in the unirrigated lands which should be more seen to, and the abundance of the holders of irrigated land should go in greater proportion than it does to the less fortunate so that their lot may be ameliorated.

Some expensive and some unremunerative schemes have been mentioned as necessary, and there is every reason to urge why the fortunate possessors of land on permanent canals should bear the burden thereof. . . .

APPENDIX E.

EXTRACT FROM THE SIRHIND CANAL CIRCLE OFFICE FILE No. 1-5-36 ON
COMPENSATION REGARDING THE WATER-RATES ON THE SIRHIND CANAL.

Telegram, dated Lahore, the 14th January 1909.

From—The Chief Engineer, Irrigation Works, Punjab,

To—The Superintending Engineer, Sirhind Canal Circle.

PLEASE send to reach me Delhi by 19th January brief note on result of last revision of occupiers' rate in each zone, its effect on demand, on total area irrigated and on area under each of the principal crops.

Letter, dated Camp Delhi, the 13th January 1909.

From—The Chief Secretary to Government, Punjab, Civil Department,

To—W. B. GORDON, Esq., C.I.E., Chief Engineer, Irrigation Works, Punjab.

IN connection with the proposals to raise the occupiers' rate on the Western Jumna Canal, the Lieutenant-Governor considers that one of the most important points to be borne in mind is the possible effect that such an enhancement may have on the demand for water and the area of crops that the people will irrigate. As we have some experience of the effect of a similar enhancement on the Sirhind Canal, the Lieutenant-Governor would be glad if you could furnish figures for the Sirhind Canal for some years previous, and for some years subsequent, to the enhancement made on that canal, and if you would discuss them with a view to arriving at conclusions as to—

- (i) what was the effect of the enhancement on the demand for the water on the total area irrigated and on the area of different crops irrigated ;
- (ii) whether the enhancement had any permanent effect in reducing the gross outturn of the land in the commanded area by restricting the area for which the people took water ;
- (iii) whether the enhancement led to more intensive irrigation by inducing the people to put the water available on a smaller area than before ; and
- (iv) what the effect of the enhancement has been on the average realisation of the occupiers' rate ? The Lieutenant-Governor recognises that on the Sirhind Canal the demand for water varies very much with the character of the season so that account should be taken of the amount and distribution of the rainfall in each harvest.

2. The Lieutenant-Governor asks merely for a brief examination of the points above mentioned as the question of the assessment of canal lands on the Western Jumna Canal is now before him and a reference must be made at a very early date to the Government of India to enable all settlements to be completed at the proper time.

NOTE ON THE EFFECT OF ENHANCING THE WATER-RATES IN THE BHATINDA
DIVISION FROM THE KHARIF CROP OF 1905, RECEIVED WITH EXECUTIVE
ENGINEER'S No. 124 OF 16TH JANUARY 1909.

Mr. C. G. May.

Zone No. I, Kharif.—From the statement marked A it will be seen that in the triennial period preceding the enhancement, the area irrigated was 194,953 acres, representing a water-rate of Rs. 6,30,367. In the triennial period succeeding the figures are 162,853 acres and Rs. 6,10,256, respectively. That is to say, a decrease of area of 32,100 acres and Rs. 20,111, or an average annual decrease of 10,700 acres and Rs. 6,704.

Zone No. I, Rabi.—Here the area in the triennial period preceding the enhancement was 295,393 acres, representing a water-rate of Rs. 9,84,329, and in the triennial succeeding the figures are 322,987 acres and Rs. 14,13,387, respectively. That is to say, an increase of 27,594 acres and Rs. 4,29,058, or an annual average increase of 9,198 acres and Rs. 1,43,019.

APPENDIX E.

Zone No. II, Kharif.—Here the area in the triennial preceding enhancement was 98,119 acres representing a water-rate of Rs. 2,66,753 ; in the triennial succeeding, this becomes 88,484 acres and Rs. 2,69,100. That is to say, a decrease in the area of 10,635 acres and an increase in the water-rate of Rs. 2,347, or an annual average increase in the water-rate of Rs. 782 and a decrease in area of 3,545 acres.

Zone No. II, Rabi.—Area in the triennial period preceding the enhancement was 199,158 acres, representing a water-rate of Rs. 6,51,764 ; in the triennial period succeeding, the figures are 178,116 acres and Rs. 6,88,047, respectively. That is to say, a decrease in area of 21,052 acres and an increase in the water-rate of Rs. 16,283, averaging annually 7,017 acres and Rs. 5,428.

Crops effected—*vide* statement B.

The following figures show the average annual increase or decrease :—

					Acres.
<i>Kharif</i> —					
Sugarcane	...	...	...	—	1,197
Maize	...	...	...	—	5,292
Cotton	...	...	...	—	672
Jowar chari	...	...	...	+	5,541
Miscellaneous	..	...	...	—	12,291
<i>Rabi</i> —					
Wheat	...	...	...	+	16,488
Barley	...	...	...	—	2,972
Mixed grains	...	...	...	—	5,822
Sarson	...	...	...	—	4,188
Gram	...	...	...	—	3,358
Senji	..	...	...	+	1,607
Miscellaneous	...	...	...	—	121

The above constitute the statistics on the subject, and certain effects are visible enough, but for reasons mentioned below the causes can be many.

It is well known that the land commanded by this division is of a sandy nature that is capable of absorbing and storing moisture easily ; it is clear therefore that in years of good rainfall sufficient moisture can be absorbed to mature crops without the aid of canal irrigation.

This being so, it is also evident that the conditions of rainfall have much to do with any increase or decrease in irrigation, and must therefore be the first consideration when causes are assigned to explain certain effects.

The statements accompanying have been framed from the crop figures of three years preceding, and three years succeeding, the enhancement of rates ; personally I do not think that deductions made therefrom can be anything but misleading, or at any rate to a great extent.

If the cultivators had been in the habit of irrigating to the same extent year after year, it would have been possible to see the effect of a particular thing, say, the enhancement of water-rates ; but where other causes, often of greater importance, come in, it is not possible to gauge the exact effect of any particular one.

The rabi of 1907-08 may be taken as an example to illustrate the whole effect the enhancement of water-rates has had.

This was a crop in which the demand was intense ; all we could supply was eagerly utilised ; the rate to be charged was of no consequence, provided we gave them enough to mature their crop. In fact, where a distributary was cut by zamindars, and I tried to pacify those lower down the same distributary by telling them that the men that cut the channel would have to pay double rates, this only evoked the remark that that was no punishment at all, since in a year like this it paid a zamindar to pay double or treble the water-rate, provided he was given water, either to sow or mature his crop. —Al my experience shows that this is quite the truth.

APPENDIX E.

Of course it is quite possible that the enhancement of the water-rate has had effects on certain crops ; but, generally speaking, since I came to this division three years ago, I have never heard anyone grumble at excessive rates ; in fact, I can only recall two instances on which the increase has been even alluded to.

Perhaps something ought to be said with reference to decreases of principal crops.

Sugarcane.—The enhancing of the rate has probably had some effect in reducing the area annually raised, but it must be remembered that the area was never very great ; the crop occupies the land for two crops ; there is much labour attached to it, and where the cultivation is not taken up universally economies of production cannot be practised.

Often in a village I have seen a single cultivator with a single field of sugarcane ; the result is he is very handicapped for he has to watch day after day ; whereas there were others he would only watch once in four or five days ; then as there is practically no other cultivation in the early days of the crop, the one man has to see to the maintenance of the water-course ; again he has to hire or buy a pressing machine single-handed ; much more could be said in this connection, but perhaps enough has been said. It is just possible that the enhancing of the rate turned the balance.

Maize.—This is about the only better class of crop cultivated on this canal in the kharif ; in itself it is too small, and therefore not enough to create a sufficiently strong demand to keep distributaries running for the time it is in the ground ; it is cultivated principally in the upper parts of the division, and the demand is erratic ; sometimes only one or two villages on a large distributary want water. However, as the population increases, as also competition, an increase in the cultivation of maize, cotton and sugarcane will all tend to keeping a good demand to the mutual advantage of all three crops, as is the case on all the other canals.

It must also be remembered that the cultivator on this canal has always laid greatest stress on his rabi, and this continues to do till such time as the pressure of population does not force him to do a kharif.

Cotton.—This has also never been an extensive crop, and no doubt the advent of the boll-worm has had its effect here, as elsewhere.

Wheat.—The increase in this shows that the people of a part in the habit of producing for export do not think the rate excessive.

Barley, mixed grains and gram.—Probably the decrease here has gone towards making up the increase in wheat as the most paying crop, or it may be that the decrease is only part and parcel of the general decrease.

Sarson.—This has not been a popular crop for the last few years owing to severe frosts having nipped crops.

Unofficial No. 179, dated the 16th January 1919.

From—A. E. JEFFERIES, Esq., Executive Engineer, Ferozepore Division, Sirhind Canal,

To—W. J. A. BRAD, Esq., Superintending Engineer, Sirhind Canal Circle.

Your wire No. 119, dated 15th January 1909.

I HAVE the honour to submit a statement showing the area irrigated of the principal crops for three rabi seasons and four kharif seasons preceding and succeeding the enhancement of occupiers' rates.

I am of opinion that the enhancement of rates has not had any effect on the demand for canal water in the case of the principal crops.

Sugarcane alone shows a decided decrease, but this crop had been dwindling even before the enhancement. It does not do well here, and was always a small crop.

Barley shows a shortage on the average, but there is no crop that varies so much with the state of the rainfall ; it is here always a "makeshift" crop.

APPENDIX E.

Then it attained its maximum in rabi 1907-08 as the rains had failed and rabi sowings were very late.

Sanson.—This is an uncertain crop, and depends largely on rainfall.

I think that this crop is dwindling because it has suffered so largely from insects. It is a popular barani crop, and can usually be matured on rain. It is a very paying crop, and it is quite unlikely that the small increase from Rs. 3-12-0 to Rs. 4 in zone I has anything to do with the shortage. There was no increase in zone II (on rate).

Gnam, of which the increase of rate was heavy, has remained full stationary, and shows a slight increase on the average.

Cotton.—In spite of the boll-worm, shows no decrease.

Mrize, Chari and Bajra show an increase.

The enhanced value of all agricultural produce has more than compensated the zamindars for the increased water-rates.

I am to take this opportunity of drawing attention to the fact that but little maize and cotton is grown in zone II, and to urge that some kind of bonus be offered to the people as an inducement to grow these crops.

I am sure they would grow well under some variation of treatment from the usual treatment common further east.

No. 05, dated the 17th January 1909.

From—C. G. MAY, Esq., Executive Engineer, Bhatinda Division, Sirhind Canal,
To—W. J. A. BRAD, Esq., Superintending Engineer, Sirhind Canal Circle.

In continuation of this office No. 124, dated 16th instant, and in compliance with your wire No. 131, dated 16th instant, received by me in camp on 17th, I have the honour to make the following further comments in the hope that they may be in time to be of use.

Taking up the points *seriatim*—

As far as I can see, the demand for water was not affected in the least by the enhancement of the rate; it was entirely dependent on the rainfall; if deficient, water was in strong demand, and generally short of requirements.

2. The answer to this depends on 1, if water was required, it was taken, the area was not restricted: all that happened was that it was classed as barani instead of "nahri".

3. As far as it is possible to see, there has been no attempt to restrict the area and intensify irrigation.

4. The balance at the end of the year is generally about Rs. 5,000, and there is therefore little, or no visible, effect on realisation.

Note by Rai Bahadur BAIY NATH, C.E., Executive Engineer, Ludhiana Division, Sirhind Canal, on the enhancement of occupiers' rates on the Sirhind Canal, forwarded with his No. 35 C, dated the 18th January 1909, to the Superintending Engineer, Sirhind Canal Circle.

1. (a) *Effect of the enhancement on the demand for the water on the total area irrigated*.—The accompanying statement No. I shows the total areas irrigated in the Ludhiana Division for each crop during the five years preceding and three years succeeding the enhancement of rates coming into force. I have not taken figures prior to 1900-01 because it was from that year that the Bhatinda Division was constituted, and figures of previous years cannot be compared because they included areas subsequently transferred to the Bhatinda Division.

The average total area for the two years 1900-02 was 140,835 acres. From rabi 1902-03 came the great change in this Division, *viz.*, certain distributaries were converted into kharif channels. This contracted the rabi area; therefore the average total area for the three years 1902-05 fell to 113,356 acres only.

APPENDIX E.

After this triennium was introduced the enhanced scale of rates, and the average total area of the triennium succeeding the enhancement is 114,189 acres, i.e., more than that of the three years preceding the enhancement.

But examining the figures more closely, it will be seen that in the triennium preceding the enhancement, there are no abnormally high figures for the kharif or rabi crops, but in the triennium succeeding, the year 1905-06 has the abnormal total of 144,822 acres, which is due to the abnormal rabi figure of 91,910 acres. It may be remarked that this was due to the fact that the kharif channels were specially authorised to remain open till the end of October that year, and a large area of rabi crops was picked up on kharif channels.

If therefore we omit the year 1905-06, and also take into consideration that the higher schedule of rates had not yet been put into effect and was for the first time to be put into effect that year, and was therefore not very universally known, we get for the two next years the average of $\frac{107,446 + 91,49}{2} = 99,247$ acres, which is very much below the average total of the three years preceding the enhancement, and indicates a reduction in the irrigated area. This again includes the abnormally low figure of kharif 1908, viz., 26,883 acres, and thus reduces the average. This very low kharif was due to plentiful and timely rainfall, and had nothing to do with the question of rates. Again the rabi 1907-08 was higher than usual, but of the 64,166 acres over 11,000, or about 22 per cent., failed, and was remitted. The reason for such a large failure was of course the fact that at the time of sowing the people spread what water they got over as large an area as they could, and for maturing they failed to receive any help from rainfall and the water was not sufficient for the large area initially covered. This feature, however, indicates one point: that the enhanced rates did not prevent the people from increasing the area of irrigation, the chief cause of which is the prevalence of high prices. But I may here mention that, with the introduction of the revised schedule of rates, the crops grown on the "Wadh" of a previous crop was introduced into class V at Rs. 1-8-0 per acre; and this has gone up from very little to over 7,000. The following are the exact figures of the Wadh Wattar under this class, which is really *no fresh* irrigation:—

						Acres.
1903-04	...	...	...	...	...	247
1904-05	...	...	...	...	...	115
1905-06	...	...	...	...	...	6,805
1906-07	...	...	...	...	...	7,522
1907-08	...	...	...	...	...	4,454

If therefore I deduct the Wadh Wattar areas from the last three years' irrigation, the total of the triennium will be reduced from 313,317 acres to 324,531, and the average yearly will be 108,177 acres, which again is much less than that of the previous three years, even including the abnormal figures of rabi 1905-06 and kharif 1908.

Conclusion.—From the above discussion of the figures, I come to the conclusion that it is not safe to draw deductions from the figures of these three years since enhancement because the character of the season has been so very changing all along. One thing is certain: that leaving out the "Wadh Wattar" areas, there seems to be some reduction comparatively.

(b) *Effect of the enhancement on the demand for the water on the area of different crops irrigated.*—Statement No. II shows the areas irrigated by different crops in the Ludhiana Division for the last eight years. Averages have been given for the two years 1900-02 prior to certain channels becoming kharif distributaries, the three years 1902-05 preceding the enhancement of rates and the three years 1905-08 after the enhancement of rates.

Sugarcane.—This high-class crop of this district has doubly suffered. The average prior to 1902-03 was 5,336 acres. When some of the channels in the division were made kharif channels, the sugarcane sowings received a

APPENDIX E.

sudden check, and the average of the triennium 1902-05 fell to 2,795 acres, or about half the previous average. This was prior to the enhancement of the rate of sugarcane from Rs. 7-8-0 to Rs. 12 per acre. The average of the triennium 1905-08, *i.e.*, after enhancement, is 1,427 acres, or it is further halved.

The percentage of this crop to the total area irrigated was never very high, and was always about $3\frac{1}{2}$ to 4 per cent. But its total extinction is also undesirable. It may be said that the cause of its dwindling away is not so much the high rate, but the cheap imported sugar.

This is all the more reason that its rate should not become prohibitive, and its cultivation should be encouraged, which, I venture to suggest, would be the case under a lower rate per acre, which would afford very reasonable relief.

Maize.—The averages are—

				Acres.
2 years 1900-02	...	...	...	33,285
3 years 1902-05	...	...	...	35,466
3 years 1905-08	...	...	...	25,708

This shows great decrease of this crop, but in the average of the last three years the abnormally low kharif 1908 is included. Excluding that crop, the average would be 29,672 acres which also is much below the previous two averages. The rate of maize was Rs. 4-8-0 per acre, and this has been raised to Rs. 5-4-0. This may partly account for the decrease, or it may be the variable character of the rainfall which has affected the area under this crop. It is rather early to pronounce a definite opinion and to say that it is this enhancement in its rate which has restricted its area.

Cotton.—The rate per acre of cotton was raised by only 4 annas, from Rs. 3-12-0 to Rs. 4. This has had no effect on the area, and in spite of the boll-worm, the area under cotton has increased as below :—

				Acres.
Average of 1900-02	...	...	...	1,817
" " 1902-05	...	...	...	2,584
" " 1905-08	...	...	...	3,130

The reason of this steady increase of area under cotton is the springing up of the cotton factories in the district, and if its production was made cheaper, I dare say greater areas of cotton would be sown on this canal in this division as the soil is very well suited to the crop, and its production would be useful in every way. The total area under this crop is, however, about $2\frac{1}{2}$ per cent. of the total, and is therefore not very significant.

Jowar and chari.—The rate of this crop was raised from Rs. 2-10-0 to Rs. 3-4-0 ; the area under it has varied as below :—

				Acres.
1900-02	...	...	...	14,407
1902-05	...	...	...	10,826
1905-08	...	...	...	11,019

As a fodder crop, it is indispensable to the agriculturist. Therefore the small increase in rate has not had any effect on the area ; and to keep up his cattle the zamindar still finds that it pays him to grow as much of this crop as is required for his use.

Wheat.—In the old schedule of rates wheat was classed as a class III rate, being Rs. 3-12-0 an acre. In the new schedule it was raised to the class II rate—Rs. 5-4-0. So that, excepting sugarcane, the enhancement was very high in this principal crop, and it is worth considering it in detail. The

APPENDIX E.

following table shows the areas under wheat on some of the principal canals in the province for the last eight years :—

Year.	Sirhind Canal.	Upper Bari Doab Canal.	Western Jumna Canal.	Lower Chenab Canal.	Lower Jhelum Canal.
	Acres.	Acres.	Acres.	Acres.	Acres.
1900-01	120,654	197,756	110,870	825,087	...
1901-02	214,164	260,118	228,488	796,332	50,002
1902-03	161,052	118,030	190,281	822,356	92,636
1903-04	183,414	224,869	320,511	907,248	154,200
1904-05	241,447	269,723	231,151	907,148	169,923
1905-06	249,907	279,065	265,019	961,270	277,803
1906-07	227,428	...	...	...	...
1907-08	252,966	...	...	...	...

This table clearly established the fact that everywhere areas under wheat have risen by leaps and bounds. Therefore it is no wonder that on the Sirhind Canal also the area has not fallen low on account of the high occupiers' rate. The prices in the market have gone up, of late years, so high that the enhanced occupiers' rate cannot be felt by the agriculturist so long as exporters of wheat are ready to recoup him several times over by offering high values. It is this high market value of wheat which keeps up this crop. But the increase on the Sirhind Canal is not so marked as on the other canals. In this division particularly this crop has fared as below :—

	Acres.
1900-01	24,500
1901-02	408,210
1902-03	25,440
1903-04	21,095
1904-05	33,697
1905-06	52,371
1906-07	23,516
1907-08	44,639

Now the high figure of 40,821 acres in 1901-02 was prior to conversion of channels into kharif distributaries. The next three years' average is only 26,747 acres.

But when the rates were enhanced, the very first rabi 1905-06 had as much as 52,371 acres. The reason that the rainfall of the preceding monsoon was copious and left moisture in the land on which a large area of barani wheat was raised. As rains held out till after January 1906 a very large area of barani wheat was irrigated and became nahri. This was the year when the new rates were first to be levied, and the agriculturists cannot be said to have been fully conversant with them. The very next year it fell to 23,516 acres. In 1907-08 however, the area again rose to 44,639, but 22 per cent. of it failed and had to be remitted. Here again it is not possible to pronounce one way or the other as to the effect of the enhancement. Wheat being the staple food of the well-to-do classes in India, as well as a principal article of export, is sure to command high prices, and thus the severity of a high rate cannot be felt. The high rate therefore would remain justified as long as the market value keeps high. But, so far, it has had no effect on the area under wheat.

APPENDIX E.

Barley.—This was raised from Rs. 3-12-0 to Rs. 4. Its averages have been—

					Acres.
1900-02	...	...	...	...	2,920
1902-05	...	...	...	...	832
1905-08	...	...	...	...	2,817

Thus on this crop there has not been any effect.

Mixed grains.—On this also the increase is very small—Rs. 3-12-0 to Rs. 4—but the area has nearly dwindled away—

					Acres.
1900-02	...	...	...	...	21,495
1902-05	...	...	...	...	13,601
1905-08	...	...	...	...	686

This crop seems to have suffered not from the high rate, but from the conversion of channels to kharif distributaries.

Sarson.—In this division sarson is a very insignificant, and an unknown, crop.

Gram.—This crop has also been very much restricted, but I cannot attribute it to its enhanced rate, which was raised from Rs. 2-10-0 to Rs. 3-4-0.

The averages are—

					Acres.
1900-02	...	...	...	...	10,475
1902-05	...	...	...	...	10,188
1905-08	...	...	...	...	5,137

so that during last three years it is halved. I think the decrease is due to its being attacked by an insect called "sundhi".

Senji.—Senji is a fodder crop, and, like jowar and chari, it has not suffered, and the three averages are 6,506, 5,009 and 7,330 acres, respectively.

General.—A perusal of statement No. II will show that the total area irrigated in the division is not less than it was before enhancement, but columns of classes V and VI will show that as much as 12,609 acres of the total average of 114,439 acres is under these new classes of "Wadh Wattar" and Rauni. Excluding these the average is 101,830 acres, which is below the previous triennial average. A statement (No. III) of rainfall at four principal stations for the last eight years is enclosed, and will show how variable the natural conditions have been.

Permanent effect of enhancement in reducing the gross outturn of the land in the commanded area by restricting the area for which people took water.—It has been fully shown above that the area for which people take water has not been restricted, and on the contrary the figures show that the area on which water was spread is greater than before. So the outturn of the land in the commanded area cannot be said to have decreased. It is, however, on the increase always; the reasons are not far to seek:—

- (1) Years of drought and famine which raised prices so high.
- (2) Consequent economy in canal water exercised by the irrigators.
- (3) Spreading water over larger areas in the hope of rainfall.
- (4) Holdings in this division are very small and population extensive.

This means that the men must continue to live on land for which they still consider canal irrigation as the best, and the only, means of producing their livelihood.

- (5) Nahri lands have become so used to canal water that if left unirrigated, the owner or tiller would be disappointed in the produce.

For these various reasons the zamindars have stuck to canal irrigation as if nothing had happened, and have not, so to say, in any way shown the effect of enhancement of rates.

APPENDIX E.

Whether the enhancement led to more intensive irrigation by inducing the people to put the water available on a smaller area than before.—This feature has not been noticed so far. The people always expect and wait for the rains, and as explained before always try to spread water on a larger area so that the area may not remain uncultivated for which also they would have to pay land revenue. To escape this they try to raise an irrigated crop. The following figures show that irrigation has not been intensive :—

Year.	DUTY ON SUPPLY UTILIZED ON SIRHIND CANAL BRANCHES.		REMARKS.
	Kharif.	Rabi.	
1900-01	101	110	The duty per cusec utilized has been steadily on the increase, which shows the tendency has been to extensive irrigation, instead of intensive. The question of rates has not affected this item.
1901-02	55	177	
1902-03	81	160	
1903-04	81	169	
1904-05	98	194	
1905-06	88	177	
1906-07	103	172	
1907-08	100	216	

What the effect of the enhancement has been on the average realization of occupiers' rate

* * * * *

These figures of this canal clearly show there has been absolutely no difficulty in the realization of the demand for occupiers' rates.

The average realizations therefore have remained unaffected by the enhancement of the rates.

Concluding remarks.—In the above note I have discussed in detail every side of the question, and have tried to draw conclusions from the figures available. But I consider it only just, and a part of my duty, to put it on record that I am not convinced by the features indicated by the figures of this single triennium since the enhancement, and consider that it is yet too early to judge of the effects of the enhancement of rates on this canal. Therefore, other things being equal and similar, I would not recommend any enhancement elsewhere on the conclusions which can so far be drawn from the more or less experimental figures of this canal.

NOTE ON ENHANCEMENT OF WATER-RATES BY A. E. JAFFERIES, ESQUIRE,
EXECUTIVE ENGINEER, FEROZEPUR DIVISION, SIRHIND CANAL, FOR-
WARDED WITH HIS NO. 175, DATED 27TH JANUARY 1909, TO THE
CHIEF ENGINEER, IRRIGATION WORKS, PUNJAB.

In this office wire dated 26th January 1909 it was reported that the percentage of realization to demand before and after enhancement was 98 and 99, respectively.

The figures on which this was based are attached, but an error was afterwards found in it as marked in red, and the corrected figures showed that the realization was actually greater than the demand.

The fact is the realizations, as taken from the revenue report, include figures due to previous crops.

2. I have therefore taken as the fairest standard available the information given in the half-yearly form No. VI, viz., total demand for crop and total realization for crop on 31st March and 30th September each year.

APPENDIX E.

3. The kharif demand is submitted on 15th December; hence the realizations by 31st March is a very good test of the degree of ease in recovering the assessment; similarly the rabi demand being made before the end of May and the realization by the end of September, only four months later, is a good test.

4. In the statement attached the figures are not complicated by the demands or realizations of other crops.

5. In 1902 kharif the realization up to 31st March was only 65 per cent. There must have been special causes for this, hence I omit this crop.

6. But for the two kharifs preceding enhancement the percentages were 88 and 96, respectively. While for three kharifs succeeding they were 98, 100 and 98.

Similarly in the rabi we have—

Before 92, 98 and 99

After 99, 99, 99

7. There is therefore no reason whatever to think that the enhancement of rate has led to any delay in making realizations.

The great rise in the value of food-stuffs and the increasing prosperity of the zamindars has, if anything, made realization easier and quicker than before.

APPENDIX E.

No. 2003-S. (Rev.), dated Lahore, the 17th August 1912.

From—The Hon'ble Mr. H. P. TOLLINGTON, I.C.S., Revenue Secretary to Government, Punjab,
To—The Junior Secretary to the Financial Commissioner, Punjab.

I AM directed to refer to Mr. Williamson's letter No. 264, dated the 27th March 1911, on the subject of *nahri-parta* and occupiers' rates in the Ludhiana District.

2. In reply, I am to say that the Lieutenant-Governor agrees generally with the proposals of the Financial Commissioner, but that as regards the rules for the assessment of areas to which canal irrigation may be extended or from which it may be withdrawn, the system proposed by the Settlement Officer, with the amendments suggested by the Commissioner in his letter, No. 6773, dated 15th-18th December 1911, may be tried, pending a final decision which will be arrived at on the termination of the Ferozepore settlement. In the meantime, since it is clearly desirable to have one system for the whole canal if possible, it should be considered, in the light of the experience gained, which system is best.

3. * * * * *

No. 2004-S. (Rev.).

COPY forwarded to the Chief Engineer, Irrigation Works, Punjab, with reference to his letter No. 6200-R. I., dated the 30th July 1912, for information, and with the request that the required report may be submitted as soon as possible for His Honour's information.

Endorsement by the Chief Engineer, Irrigation Works, Punjab.

No. 0301-R. I., dated Lahore, the 6th September 1912.

COPY forwarded to F. W. Carne, Esquire, Superintending Engineer, Sirhind Canal Circle, for information, with reference to his No. 1649, of 4th June 1912.

No. 0407-R. I., dated Lahore, the 14th October 1912.

From—W. E. T. BENNETT, Esq., C.S.I., Chief Engineer, Irrigation Works, Punjab,
To—The Junior Secretary to the Financial Commissioner, Punjab.

WITH reference to your letter No. 6893, dated 3rd October 1912, regarding the indirect credit due to the Irrigation Department consequent on the resettlement of the Ludhiana District, I have the honour to state that I accept the proposed credit which is to be given to this department from the introduction of the new assessment, *i.e.*, kharif 1912.

No. 0408-R. I.

COPY, with copy of Junior Secretary to Financial Commissioner's letter, No. 6893, dated 3rd October 1912, with enclosure, to which it is a reply, forwarded to F. W. Carne, Esquire, Superintending Engineer, Sirhind Canal Circle, for information, in continuation of this office endorsement No. 0301-R. I., of 6th September 1912.

No. 6893, dated Lahore, the 3rd October 1912.

From—H. A. SMITH, Esq., Junior Secretary to the Financial Commissioner, Punjab,
To—W. E. T. BENNETT, Esq., C.S.I., Chief Engineer, Irrigation Works, Punjab.

WITH reference to Punjab Government endorsement No. 2004-S. (Rev.), dated 17th August 1912, to your address, I am directed to enclose a copy of the

1. Extract paragraph 3 of the note dated 9th November 1911 recorded by the Settlement Officer, Ludhiana.

2. Financial Commissioner's letter No. 264, dated 27th March 1912, to the Punjab Government.

correspondence marginally noted on the subject of the indirect credit due to the Irrigation Department consequent on the resettlement of the Ludhiana District, and to enquire whether the Irrigation Department agrees to the amount of the indirect credit proposed by the Settlement Officer.

APPENDIX E.

2. I am to add that the credit should be given with effect from the introduction of the new assessment, i.e., kharif 1912.

Extract paragraph 3 from the note dated 9th November 1911 recorded by the Settlement Officer, Ludhiana

3. *Credit of the nahri-parta to the Irrigation Department.*—The disposal of the nahri-parta among Government accounts is probably *resjudicata*. Assuming that this is so, I have only to report the total value of the nahri-parta.

All chahi-nahri has been assessed as chahi-niai, canal water is used only to supplement, or partly replace, well water on such lands, and no portion of the enhanced demand can therefore be regarded as due to the introduction of canal water into the chahi chaks. I exclude chahi-nahri from the calculation of the gross nahri-parta, which is as follows :—

1	2	3	4
Circle.	Recorded-nahri area in acres.	Proposed nahri-parta per acre.	Value of nahri-parta.
		Rs. A. P.	Rs. A. P.
Jagraon Dhais Circles ...	10,600	0 8 0	9,761 8 0
Ludhiana Dhais Circles ...	7,459	0 6 0	2,798 12 0
Powadh ...	617	0 8 0	309 8 0
Jangal ...	13,870	0 6 0	5,189 10 0
TOTAL ...	42,458	...	18,079 0 0

No. 104-2731, dated Lahore, the 27th March 1912.

From—H. S. WILLIAMSON, Esq., Junior Secretary to the Financial Commissioner, Punjab,

To—The Hon'ble Mr. H. P. TOLSTON, I.C.S., Revenue Secretary to Government, Punjab

I AM directed to submit, for the orders of Government, a copy of a letter No. 6773, dated 15th December 1911, with enclosures, from the Commissioner of Jullundur on the subject of nahri-parta and occupiers' rates in the Ludhiana District.

2. In regard to the pitch of the *nahri-parta*, the Financial Commissioner agrees in the views expressed in paragraph 3 of Mr. Fagan's letter, and he recommends for sanction the rates there proposed.

3. Mr. Diack also agrees with the Commissioner that the Settlement Officer's estimate at Rs. 18,079 of the indirect credit which should be allowed to the Irrigation Department from the land revenue of the district may be approved.

4. The Settlement Officer's proposals as to the proportion of land revenue in jagir villages that is to be treated as *khalsa* because due to canal irrigation are, in the Financial Commissioner's opinion, suitable.

5. The Financial Commissioner also agrees with the Commissioner that the Native States concerned have no claim to any share of the income from nahri-parta.

6. As regards Mr. Dunnett's proposed rules for the assessment of areas to which canal irrigation may be extended or from which it may be withdrawn in future, the Financial Commissioner agrees in the criticisms contained in

APPENDIX E.

paragraphs 10 and 12 of Mr. Fagan's letter. Further, Mr. Diack is opposed to multiplying sets of rules for the assessment of *nāhri-parta*, and as a suitable and typical set of rules has been worked out for Gurgaon in the correspondence ending with Financial Commissioner's letter No. 167, dated 18th June 1910 [Proceedings, Revenue and Industries (Revenue), Nos. 61, 62 and 63 for June 1910], the Financial Commissioner thinks we should try to adapt them for use in Ludhiana. The Settlement Officer's rules are drafted to meet cases of change in the size and position of outlets, and the Financial Commissioner thinks his objects will be attained if the following additions are made to the Gurgaon rules in Proceedings No. 63 above referred to. The addition will of course for the present be applicable to Ludhiana only—

- (i) Rule 6 should *read*.—“If a sum resulting from the application of the rates detailed in rule 4 to the area defined in rule 5 is less than Rs. 50, or than $\frac{1}{10}$ th of the revenue of the village (whichever is less) no further action will be taken, *except as provided in rule 7-A*, but the field kanungo will note the result of the calculation in his attestation note in the jamabandi, and the tahsildar or naib-tahsildar who attests the jamabandi should check the calculation, and should state in his attestation note that he has done so.”
- (ii) Between rules 7 and 8 *insert* rule 7-A.—“Even if the above sum is less than Rs. 30, the Deputy Commissioner may direct the patwari to prepare a list in the form prescribed in rule 7, if, in consequence of the position of an outlet having been altered, the Deputy Commissioner is of opinion that an appreciable alteration has occurred in the area benefited by canal irrigation necessitating the transfer of the *nāhri-parta* from one set of fields to another.”
- (iii) *Add* after rule 11—
“12. If a reduction allowed under rule 9 is due to an outlet having been closed, then the reduction shall be allowed with retrospective effect from the season of closure.”

7. The Financial Commissioner agrees with the Commissioner and Settlement Officer that separate zones for occupiers' rates are not required, and that no progress can be made at present with the scheme for having contracts for water-rates.

No. P. W.-6-167, dated Lahore, the 3rd December 1913.

From—The Accountant-General, Punjab,

To—F. E. Gwyther, Esq., Secretary to Government, Punjab, Public Works Department, Irrigation Branch.

In forwarding herewith copy of letter No. 2086, dated the 11th November 1913, from the Deputy Commissioner, Ludhiana, to my address, together with its enclosures, I have the honour to request that the sum of Rs. 18,185 on account of indirect revenue of the Sirhind Canal may be taken into account in your half-yearly statement of land revenue, for which the Irrigation Department is entitled to take a book credit, as no adjustment on account of the same is made in my office.

No. 2086, dated Ludhiana, the 11th November 1913.

From—The Deputy Commissioner, Ludhiana,

To—The Accountant-General, Punjab.

With reference to the enclosed copy of the correspondence noted in

1. Copy of Junior Secretary to Financial Commissioner, Punjab's, letter No. 7511, dated the 28th October 1912, to the address of Commissioner Jullundur Division, together with Commissioner, Jullundur Division's, endorsement No. 5860, dated the 8th November 1912.

2. This office letter No. 321, dated the 1st October 1913, to the address of Commissioner, Jullundur Division.

3. Copy of Financial Commissioner, Punjab's, letter No. 7136, dated the 27th October 1913, received with Commissioner, Jullundur Division's, endorsement No. 6487, dated the 2nd November 1913,

the margin, I have the honour to request that you will kindly have the necessary book adjustment of Rs. 18,185 carried out in your office and to inform this when this is done.

APPENDIX E.

No. 821, dated Ludhiana, the 1st October 1913.

From—The Deputy Commissioner, Ludhiana,

To—The Commissioner and Superintendent, Jullundur Division.

WITH reference to the correspondence ending with your endorsement No. 5830, dated 8th November last, forwarding copy of Junior Secretary to Financial Commissioner, Punjab's, letter No. 7511, dated 28th October 1912, intimating that the Irrigation Department have accepted indirect credit for Rs. 18,079 on the Sirhind Canal, I have the honour to report that the recorded nahri area given for the Jagraon Dhaia Circles in paragraph 3 of the note which formed an enclosure to the Settlement Officer, Ludhiana's, letter No. 551, dated 9th November 1911, was wrongly shown as 19,567, instead of 19,781, acres.

The corrected figures should be as follows :—

<i>Name of circle.</i>	<i>Area in acres.</i>	<i>Value of nahri-parts.</i>
		Rs.
Jagraon Dhaia Circles	... 19,781	9,890-8-0
TOTAL DISTRICT	... 41,695	18,185-6-0

The mistake was detected recently when the statements for the levy of occupiers' rate in the year 1913-14 were under preparation. I would request that necessary approval of the Financial Commissioner, Punjab, may be obtained to the revised figures quoted above.

No. 7511, dated Lahore, the 28th October 1913.

From—The Junior Secretary to the Financial Commissioner, Punjab,

To—The Commissioner, Jullundur Division.

IN continuation of this office endorsement No. 2582, dated 27th March last, I am directed to inform you that the Irrigation Department have accepted the indirect credit of Rs. 18,079 on the Sirhind Canal, and to request that you will instruct the Deputy Commissioner, Ludhiana, to give indirect credit to that department with effect from kharif 1912 in the form prescribed by paragraph 48 of standing order 61.

No. 5830.

COPY forwarded to T. Miller, Esquire, Deputy Commissioner, Ludhiana, for favour of needful action, in continuation of the correspondence ending with this office No. 4675, dated 11th September 1912.

Endorsement by the Financial Commissioner, Punjab.

No. 7136, dated Lahore, the 27th October 1913.

COPY of Commissioner, Jullundur's, endorsement No. 5996, dated 11th instant, forwarded to F. E. Gwyther, Esquire, O.S.I., Chief Engineer, Irrigation Works, Punjab, for information, with reference to the correspondence ending with his letter No. 0407-R. I., dated 14th October 1912, and with an intimation that the Commissioner has been asked to direct the Deputy Commissioner, Ludhiana, to give the indirect credit to the Irrigation Department for the back harvests, beginning with kharif 1912, at the revised figures.

No 7137.

COPY of above forwarded to Lieutenant-Colonel F. Popham Young, O.I.E., Commissioner, Jullundur Division, for information, with reference to his endorsement No. 5996, dated 11th instant,

No. 6487.

COPY forwarded to the Deputy Commissioner, Ludhiana, for information and needful action, with reference to his letter No. 321, dated 1st October 1913.

Endorsement by the Chief Engineer, Irrigation Works, Punjab.

No. 1480-R. I., dated Lahore, the 17th December 1913.

COPY forwarded to F. W. Carne, Esquire, Superintending Engineer, Sirhind Canal Circle, for information, in continuation of this office endorsement No. 1344-R. I., dated 6th November 1913, with the request that he will arrange for the credit of Rs. 18,185 being afforded to this department in form No. VI which the Deputy Commissioner supplies monthly to the Executive Engineer in direct communication with the Deputy Commissioner, Ludhiana.

No 838-C, dated 31st January 1914.

From—F. W. CARNE, Esq., Superintending Engineer, Sirhind Canal Circle,
To—The Settlement Officer, Ferozepore District.

NAHRI-PARTA.

I HAVE the honour to enquire how it is proposed to levy the "nahri-parta" in the new settlement of the Ferozepore District.

2. You will have noticed that in some villages the actual irrigated area is much more than in others. It is on this account that certain reductions in sizes of outlets have been recently made; that is to say, so as to adjust the irrigation.

3. In the Ferozepore District, with the three exceptions noted below the permissible area of irrigation per annum is 40 per cent. of the area included under command of each distributary.

The exceptions are—

				Per cent.
The Sarawan Distributary	...	...	...	45
The Aspal	„	...	...	50
The Panjawa	„	...	...	50

4. If the percentages noted are much exceeded on any distributary, and at the same time there is a shortage of irrigation in the villages at and towards the tail of that distributary, then the outlets on which there is an excess of irrigation are liable to reduction in order to reduce the shortage on others.

5. Reductions in sizes of outlets are usually only resorted to when other means have failed to rectify the shortage at the tail end of a channel.

6. At times when there is a keen demand for water and there is a shortage at the tail end of a channel, and it is not expedient or practicable at that time to reduce the sizes of outlets that are taking excess supply, those outlets are tailed or closed in turn for fixed periods.

7. Whatever is done is all for the people for the purpose of making up the shortage or deficiency of supply at the tail of a channel and to equalise as far as possible the percentages of irrigation in all the villages on the channel.

8. There is no objection, I think, in basing the "nahri-parta" on the total average annual irrigation affected in the tract, but if that average be above the permissible percentages given in paragraph 3 *supra* on any particular outlets or in any particular village, we should not be obliged to go on giving sufficient water to maintain that excess area of irrigation in any particular village or on any particular outlets for it must be held that we are bound to check excess

APPENDIX E.

irrigation by any means found necessary (such as reduction in sizes of outlets) on any outlets found to be doing more than the permissible percentage in order to try and make up the deficiency on other outlets doing less than the permissible percentage.

9. To fix the "nahri-parta" for the whole period of the new assessment in each village on the areas of irrigation found in each village during say the last few years or since the last general remodelling would be impelling us to maintain the excess in many villages at the expense of others who have unfortunately been getting less than their fair share and would preclude all possibility of our ever equalizing the irrigation in all the villages of any one channel.

10. If you desire to have any further particulars on this subject, I would be glad to give them to you; or you could get further information from the Executive Engineer, Ferozepore, whose postal address is Ferozepore.

No. 207, dated Ferozepore, the 16th February 1914

From—M. M. L. CURRIE, Esq., I.C.S., Settlement Officer, Ferozepore,

To—The Superintending Engineer, Sirhind Canal Circle.

WITH reference to your No. 338-C., dated 3rd January 1914, I have the honour to say that nahri-parta in this settlement is levied on the area recorded as nahri at our measurements; that is to say, such land as has been twice irrigated in the last four years. As yet, as explained to you when we met at Kandu Khera on the 6th, it is not decided what system is to be used for readjusting the nahri-parta owing to reduction of outlets.

I have written demi-officially to the Executive Engineer, Ferozepore, before receipt of your letter and asked him to let me know what had been done in the way of reduction of outlets on the Malukpur and Daulatpur branches in particular. I have just received his reply.

No. 7462, dated Lahore, the 9th November 1915.

From—The Junior Secretary to the Financial Commissioner, Punjab,

To—The Chief Engineer, Irrigation Works, Punjab.

WITH reference to your letter No. 0119-R.I., dated the 7th July last, I am directed to state as follows:—

- (1) the year 1915 mentioned in paragraph 1 of your letter under reply is the year 1915-16;
- (2) the years 1913 and 1914 mentioned in paragraph 2 of the same letter are the years 1912-14 and 1914-15; and
- (3) the discrepancy pointed out in paragraph 3 of your letter is admitted. The correct credit is Rs. 50,485 for the years 1914-15.

APPENDIX E.

GRANT TO THE IRRIGATION DEPARTMENT OF A FIXED BOOK CREDIT OF
RS. 61,616 ON ACCOUNT OF NAHRI-PARTA ON THE SIRHIND CANAL IN
THE FEROZEPORE DISTRICT.

No. 834, dated Lahore, the 9th November 1915.

From—J. M. DUNNETT, Esq., I.C.S., Junior Secretary to the Financial Commissioner, Punjab,
To—The Revenue Secretary to Government, Punjab.

I AM directed to forward copies of the letters noted in the margin, and

1. Financial Commissioner's letter
No. 4381, dated 12th June 1915, and
enclosures.2. Paragraph 1 of Chief Engineer,
Irrigation Works, letter No. 0119-R I.,
dated 7th July 1915.3. Paragraph 1(1) of Financial Com-
missioner's letter No. 7462, dated 9th
November 1915.to request that the sanction of Government may
be accorded to give the Irrigation Department a
fixed book credit of Rs. 61,616 on account of
nahri-parta on the Sirhind Canal in the Feroze-
pore District with effect from the year 1915-16.

No. 4381, dated Lahore, the 12th June 1915.

From—The Junior Secretary to the Financial Commissioner, Punjab,
To—The Chief Engineer, Irrigation Works, Punjab.

I AM directed to forward a copy of a letter No. 1958, dated the 25th March 1915, with its enclosure, from the Commissioner, Jullundur Division, and to enquire whether you are prepared to accept the credit of Rs. 61,616 with effect from the year 1915 as book credit on account of nahri-parta on the Sirhind Canal in the Ferozepore District.

2. The credits for the two preceding years for portions of the district in which the new assessment was introduced are given below :—

		Rs.
1913	... Moga for both harvests, and Feroze- pore and Mamdot for kharif only (Rs. 19,851 + 82)	... = 19,933
1914	... Muktsar for whole year, Rs. 19,339 + Fazilka for kharif only Rs. 11,130 + Rs. 19,933 for the year 1913	... = 50,402

I am to enquire if these are accepted.

3. I am to add that the credit now proposed will be correspondingly increased as the progressive enhancements fall due. When the rules for the variation of the nahri-parta assessment in consequence of variations in irrigation have been approved, arrangements will be made to communicate to you the changes in the indirect credit due to the operation of the rules.

No. 4382.

Copy of the above forwarded to the Hon'ble Mr. P. J. Fagan, Commissioner, Jullundur Division, for information, with reference to his letter No. 1958, dated 25th March 1915.

2. The proposals as to rates of nahri-parta have been accepted by the Financial Commissioner.

No. 1958, dated Jullundur, the 25th March 1915.

From—The Commissioner, Jullundur Division,
To—The Junior Secretary to the Financial Commissioner, Punjab.

I HAVE the honour to submit for orders copy of Settlement Officer, Ferozepore's, No. 320, dated the 26th February 1915, and in connection therewith, I invite attention to draft assessment, rule VIII, and procedure, rule V, received with your No. 8258, dated the 25th November 1914.

APPENDIX E.

2. With reference to paragraph 4 of Mr. Currie's letter, I have ascertained from him that the only estates concerned are two in the Ferozepore Rohi and one in the Mamdot Jagir Rohi. In the case of the former, the circle barani rate is somewhat too low, while in that of the latter, which is the only one in the circle which is irrigated by the Sirhind Canal, the area involved being some 300 acres, the circle nahri rate is somewhat too high. Under these circumstances, I support the proposals contained in paragraphs 4 and 5, as also the recommendation made in paragraph 6.

No. 320, dated Ferozepore, the 26th February 1915.

From—The Settlement Officer, Ferozepore,

To—The Commissioner, Jullundur Division.

I HAVE the honour to submit the following note on the subject of the rates of nahri-parta and the indirect credit to be allowed to the Canal Department on this account :—

NOTE.

A.—Rates nahri-parta.

The following table shows the difference between the barani and nahri Sirhind rates in those circles in which irrigation from the Sirhind Canal occurs :—

Tahsil.	Circle.	Nahri rate.	Barani rate.	Nahri-parta.
		Rs. A. P.	Rs. A. P.	Rs. A. P.
Moga	Rohi ...	1 12 0	1 6 0	0 6 0
	Grey Canals ...	1 12 0	1 4 0	0 8 0
	Maharaj ...	1 4 6	0 13 6	0 7 0
Ferozepore	Rohi ...	1 8 0	0 13 6	0 10 6
Mamdot Jagir	Rohi ...	1 0 0	0 9 9	0 6 3
	Rohi, Utar ...	0 13 0	0 9 0	0 4 0
	Kot Kapura, Utar ...	0 15 0	0 11 0	0 4 0
Muktsar	Hithar ...	0 12 0	0 7 6	0 4 6
	Rohi ...	0 8 0	0 5 6	0 2 6
Fazilka	Utar ...	0 5 0	0 4 0	0 1 0

The total sum due on account of these rates as nahri-parta was announced and explained to the people, but it was only in the Maharaj Circle and in Fazilka and in a few cases in Muktsar that the people agreed to put the whole of the nahri-parta as announced on the land recorded as nahri. In the Fazilka Tahsil I had discretion to vary the nahri-parta, and I rated nahri-jhallari at only 6 pies per acre more than barani. In a few villages on the Arniwala Distributary also I imposed a reduced rate of nahri-parta in view of the poor quality of irrigation. These villages were—

Villages.	Rate of nahri-parta.		
	Rs.	A.	P.
Ghillu	0	1 8
Ramkot	0	1 3
Bodiwala	0	2 0
Katothara	0	2 0

These reductions amounted in all to a total of Rs. 136.

APPENDIX E.

I would recommend that the rates of difference given above be adopted in future for assessing or remitting the nahri-parta when revised, except in the case of the Ferozepore Rohi and the Mamdot Jagir. The villages concerned in these circles did not place the nahri-parta on the nahri land, but used a distribution of their own; I would therefore recommend that for the Ferozepore Rohi the rate should be the same as for the adjoining Moga Grey Canals, and for the Mamdot Jagir the same as for the adjoining Muktsar, Hithar. The actual difference in the Ferozepore Rohi villages between the Sirhind nahri rates and the rate at which I assessed the barani was 7 annas.

If these proposals be accepted, the rates of nahri-parta would be as follows:—

Tahsil.	Circle.	Per acre.		
		Rs.	A.	P.
Moga	Rohi	...	0	6 0
	Maharaj	...	0	7 0
Ferozepore	Grey Canals, Rohi	...	0	8 0
Muktsar	Rohi, Utar, and Kot Kapura, Utar	...	0	4 0
	Hithar and Mamdot Jagir, Rohi	...	0	4 6
Fazilka	Rohi	...	0	2 6
	Utar	...	0	1 0

B.—Amount of indirect credit to be given to the Canal Department.

The following table shows the amount of nahri-parta assessed finally and for the initial five years of the new demand:—

Tahsil.	Circle.	NAHRI-PARTA.	
		Demand for first 5 years.	Full.
		Rs.	Rs.
Moga	Grey Canals	413	666
	Rohi	14,633	32,102
	Maharaj	4,805	9,302
Ferozepore	Rohi	118	307
Mamdot Jagir...	Rohi	47	118
Muktsar	Rohi	4,718	9,315
	Muktsar, Utar	6,200	17,309
	Kot Kapura, Utar	7,418	11,546
	Hithar	997	1,520
Fazilka	Rohi	22,175	55,684
	Utar	86	202
TOTAL DISTRICT		61,616	1,37,871

As the nahri-parta is liable to revision periodically I would recommend that the Canal Department be allowed an indirect credit of Rs. 61,616 to commence with, and that as the progressive assessments are introduced this sum

APPENDIX E.

should be increased. The first increase in the revenue due to progressive assessments falls due as follows :—

Moga Tahsil including Maharaj, kharif 1917.

Zira, Ferozepore and Muktsar, kharif 1918.

Fazilka, kharif 1919.

Extract paragraph 1 from letter No. 0119-R I., dated 7th July 1915, from the Chief Engineer, Irrigation Works, Punjab, to the Junior Secretary to the Financial Commissioner, Punjab.

WITH reference to your letter No. 4381, dated 12th June 1915, I have the honour to state that I accept the credit of Rs. 61,616 with effect from the year 1915 (which is understood to be the year 1914-15) as book credit on account of nahri-parta on the Sirhind Canal in the Ferozepore District.

* * * * *

No. 7402, dated Lahore, the 9th November 1915.

From—J. M. DUNNITT, Esq., Junior Secretary to the Financial Commissioner, Punjab,

To—The Chief Engineer, Irrigation Works, Punjab.

WITH reference to your letter No. 0119-R. I., dated the 7th July last, I am directed to state as follows :—

(1) the year 1915 mentioned in paragraph 1 of your letter under reply is the year 1915-16.

* * * * *

No. 119 (Rev. & Agri.—Rev.), dated Lahore, the 2nd December 1915.

From—The Hon'ble Mr. J. P. THOMSON, I.C.S., Revenue Secretary to Government, Punjab,

To—The Junior Secretary to the Financial Commissioner, Punjab.

IN reply to your letter No. 834, dated the 9th November 1915, I am directed to convey sanction to the Financial Commissioner's proposal to give the Irrigation Department a fixed book credit of Rs. 61,616 on account of nahri-parta on the Sirhind Canal in the Ferozepore District with effect from the year 1915-16.

Agreements in connection with existing Irrigation.

APPENDIX F.-1.

Terms of Agreement between the British Government and the States of Puttiala, Jheend and Nabha, regarding the Sirhind Canal, executed at Ambala on the one part on behalf of the British Government by Mr. Gore Ouseley, Commissioner, Ambala Division, duly empowered by His Excellency the Viceroy and Governor-General of India in Council; and on the other part on behalf of the Puttiala State by Khalifa Syud Mahomed Hoossein, Mir Munshi, duly empowered by His Highness the Maharajah of Puttiala and on behalf of the Jheend State by Sardar Tumund Singh and Lalah Mohur Singh, duly empowered by His Highness the Raja of Jheend, and on behalf of the Nabha State by Mir Munshi Ram Dayal and Sardar Bishen Singh, Adawlatti, duly empowered by His Highness the Rajah of Nabha.

1. The project to be drawn out under the exclusive control of the British Government on the general basis of taking the water in the most economical manner to those districts east of the Sutlej to which it can in an engineering point of view most advantageously be carried.

2. The original designs for the Canal works will be drawn out under the sole direction of the British Government, every possible attention being given to the wishes of the Governments of the other States concerned as to the precise direction and position of the Canals, etc., consistently with sound engineering principles.

3. On the final settlement of the project, the share of the water-supply to be allotted to the Branch Canal shall be determined on the general basis of giving a fairly equal proportion to all the districts traversed by the entire system of Canals, having regard to the lands that will actually be capable of receiving irrigation from them.

4. In the subsequent parts of this Agreement, the Ubohur and Bhuttinda Branch Canals will be referred to as the British Branches, and the Kotlah, the Central, and the Choa Branches will, for the sake of brevity, be alluded to as the Puttiala Branches, as they chiefly pass through the territory of the Puttiala State.

5. Water shall be distributed, if required and so far as practicable, from the British Branch Canals rateably to all villages along their courses whose lands can be advantageously irrigated therefrom, whether those villages are under British jurisdiction or that of any other State.

6. Similarly on the Puttiala Branches the distribution shall be made rateably to all villages, whether belonging to the Puttiala or any other State.

7. The land required for the Canals and works in connection with them shall be made over by the Government of each State traversed according to its own usage, all payments of compensation being made by the British Government in accordance with the regulations in force in several States, and the amount being dealt with as a part of the general expenditure on the Canal works.

8. Compensation will be paid for any building or house injured by the works.

9. The entire cost of the Main Canal, inclusive of original surveys and the preparation of the project, shall be borne by the British Government and Native States concerned in proportion to the water-supply allotted to each; but the whole cost of the Puttiala Branches shall be borne entirely by the States concerned in similar proportion.

N.B. — Puttiala paid the expense of the preliminary surveys and project incurred in 1862. This will be added to the general cost of the whole project, and be shared by all the parties concerned.

10. Each State will defray the entire expenditure on its own *rājbahās*, which will be designed (unless otherwise mutually agreed upon) as far as possible so as to provide separately for the lands of the several States, and will be specially assigned to the States by the British Government which will determine all doubtful points relating to this assignment.

11. The States interested in the Puttiala Branches concerned shall supply annually, to meet the cost of construction while the works are in progress, a proportion of the estimated annual outlay on the Main Canal equal to the share of the entire water-supply allotted to those Branches, as well as the whole of the funds required for those Branches in shares proportioned to the quantity of water allotted to each.

12. On completion of the works, an account will be drawn out by the British Government of the actual expenditure on those portions of the project of which the cost is to be defrayed proportionally by the several Governments, and a final statement will be prepared of the exact sum due from the several States concerned, when each State will pay or receive back any difference between its actual payments year by year and its ultimate share of the

APPENDIX F-1.

13. The above account of total cost will include the charges for the original surveys, and proper charges for establishment, etc., whether incurred by the British or any of the other Governments concerned; and credit will be given to every State for payments made by it directly.

14. Copies of such parts of the British Accounts of the expenditure on construction will be furnished periodically to the Governments of the several States concerned, so far as may be desired by them.

15. The several States concerned shall pay to the British Government an annual sum as seigniorage on the Sutlej water supplied to the Puttiala Branches, in shares proportioned to the quantity of water allotted to each.

16. The seigniorage to be paid by the States interested in the Puttiala Branches, in consideration of the water supplied to them by the British Government will be at a rate not exceeding four annas per acre.

17. The sum to be paid annually will be calculated on the area actually irrigated during the year by the British Branches of the Canal, and in proportion to the relative volumes of water passing at the time down the British and Puttiala Branches, respectively, that is to say, if, with 2,000 cubic feet per second passing down the British Branches, 200,000 acres have been irrigated, and 1,000 cubic feet per second have been at the same time discharged in the Puttiala Branches, the seigniorage to be paid would be 100,000 acres at four annas, equal to Rs. 25,000.

N. B.—The area irrigated will be the actual area, *i.e.*, an acre of double crop land will not be reckoned as two acres.

18. No seigniorage will be demanded so long as a British Canal yield no profit; and as long as the profits from the British Branches shall be so small as would render the seigniorage rate of four annas per acre, unduly high, such seigniorage shall be proportionately reduced to 1, 2, or 3 annas per acre, at the discretion of the British Government.

The British Accounts Department will determine when the Canal yield profit.

19. The first payment of seigniorage will be demanded on the eleventh year after the admission of water into the Puttiala Branches.

20. In cases of any falling-off in the annual supply of water entering the main canal channel, the British Government and the other States will share the actual supply according to the original proportion fixed, and the other States shall have no claim for compensation from the British Government on account of any such reduction of the supply.

21. The gauge registers at the regulating head of the British and Puttiala Branches shall be held to give authoritative data for calculating the quantity of water supplied.

22. No State will have any claim against the British Government on account of water escaping unused from the Branches because it is not required or used in their territories. Should the British Government realize any income from the surplus (unused) water of the Puttiala Branches the States concerned shall be entitled to claim a remission of seigniorage in proportion to the income so derived.

23. The several States shall pay the same share of the annual charges for maintenance of the Main Canal as they pay of the first cost of that portion of the works.

24. The original construction of the Puttiala Branches with their collateral works, including *rājbahās*, shall be carried out exclusively by the British Government under its own Officers, as in the case of the Main Canal and the British Branches.

25. Subsequent to the admission of water, the management of the main channels of the Puttiala Branches and their connected works shall rest entirely in the hands of the British Government, but all expenses of maintenance of these channels shall be defrayed by the several States in shares proportioned to the quantities of water allotted to each.

26. The management and distribution of water from *rājbahās* and all other arrangements connected therewith shall be under the control of, and the whole of the cost of maintenance and management of the *rājbahās* shall be defrayed by, the States to which they respectively belong.

27. The details of superintendence, powers of local Officers, and other matters connected with the management, shall be settled by the Punjab Government with the States concerned, subject to the confirmation of the Supreme Government.

28. Offenders against Canal regulations in villages irrigated from the Puttiala or British Branches, or bordering on Puttiala or British Branches, shall be made over by the Canal Officers for infliction of penalties to the Officers of the Government in whose territory those villages are situated, a right of reference to the Punjab Government being allowed in case of any dispute or difference of opinion.

29. Each State shall be bound to give a right of passage through its lands for any water channel, large or small, when required by any other of the States concerned, the only compensation claimable from the State to which such water-course belongs being the value

APPENDIX F-1.

of the land occupied and the property thereon. The supervision of rájbahás and other minor channels thus made shall remain with the Government to which they belong, as in the case of other similar works within its own territory.

30. In case of dispute between any two States as to the amount of compensation to be paid on account of land taken up, or any other matter under this Agreement, the amount of compensation or dispute shall be determined by an Officer appointed by the British Government.

31. The tolls levied on boats, rafts, etc., navigating the canals shall be the same on all the channels, whether those channels belong to the British or any other State.

32. No transit duties on goods passing along the canals shall be levied by any of the Governments concerned. This will not prevent the levy of customary duties on goods or merchandise landed from boats, etc., plying on the canals for consumption in towns, etc.

33. The amount of toll levied on through traffic shall be shared between the British Government and the States concerned, in proportion to the distance traversed on the channels belonging respectively to each.

34. A share of the navigation tolls on the Main Canal shall be allotted to the States concerned in the Pattiala Branches, in proportion to their share of the entire water-supply.

35. In all other cases the tolls shall belong to the State in exclusive possession of the channels traversed.

36. The navigation tolls to be credited to the States concerned in the Pattiala Branches thus consist of three portions:—

1st.—Share of tolls on the main canal ;

2nd—Share of "through" traffic tolls between the British and Pattiala Branches ;

3rd.—All tolls on boats, etc., navigating the Pattiala Branches, exclusively. The amount will be shared by the States concerned in proportion to the shares of the first cost of the channels defrayed by each respectively.

37. A share of the value of miscellaneous produce—such as wood, grass, etc.—on the Main Canal, shall be credited to the Pattiala Branches in proportion to the share of the water-supply allotted to them.

38. The above share of produce on the Main Canal with the whole of the value of similar produce on the Pattiala Branches (not including rájbahás) will be shared by the States concerned, in proportion to their shares in the first cost.

39. Each State will supply annually, as required, the whole of the funds for maintenance of the works, etc., appertaining to its own territory, as well as a share of the estimated cost of maintenance of the branches, *plus* the portion of the maintenance expenses of the Main Canal referred to in paragraph 23; this last in shares proportional to their shares in the first cost.

40. The British Government reserves to itself the right of extending or altering the Canal at any future time in any way it pleases, on the understanding that the share of the water first assigned to the Pattiala Branches and the other rights of the States concerned under this Agreement shall not be interfered with or diminished without their consent being first obtained. And the expenses of such extension or alteration will be distributed in proportion to the advantages expected to accrue from such action to any of the parties concerned under this Agreement.

41. So long as the original construction of the Pattiala Branches shall be in progress, it shall be the duty of the Officers in charge to pay due attention to any representations of the Chiefs of the States concerned or their Officers and to carry out their wishes as far as may be practicable or advisable.

42. In consideration of the advantages given by the Canal from the Sutlej, the Pattiala State will allow the British Government, if it desires to do so, to take a small water-course from the Ghuggur to supply the Cantonment and Town of Umballa;—the water-course to carry about 20 cubic feet per second. A proportion of the charge for seigniorage on the Sutlej water shall be remitted to compensate for the grant of the Ghuggur water if this water-course be made; no other claim to lie against the British Government in connection with the construction of the water-course.

43. In case of any difference of opinion arising between any Officers of the States concerned and the British Canal Officers on any matter relating to the management of the Canal, it shall be referred to the Lieutenant-Governor of the Punjab, whose decision shall be final. If any difference of opinion shall arise between any of the States concerned and the Lieutenant-Governor of the Punjab as to the construction of this Agreement, a reference may be made to the Governor-General in Council, whose decision shall be final.

APPENDIX F-1.

44. It shall at any time be competent for the British Government to resume the entire management of the Canal works or irrigation in the territories of any of the States concerned, if it shall consider that that State has not properly fulfilled the obligations which attach to the discharge of the duties which will devolve on it under the arrangement detailed above.

45. These obligations may be summed up as follows :—

1st.—Complete regularity in the payment of the salaries of all persons employed on the Canals, and in the provision of the funds necessary for carrying out the works, which will be needed for the proper maintenance of the canals.

If, from any want of proper attention on the part of any of the States concerned, the British Government is at any time forced to advance money for the due performance of works, or payment of salaries, etc., which will properly fall on that State under these arrangements, then the British Government must be understood to have the right to take complete charge of the whole administration of the canal channels and irrigation pertaining to that State, and to retain them under its own Officers until the evil complained of be corrected and matters be placed on a sound footing. But in such case, out of the income from the Canal after deducting expenses, any surplus which may accrue shall be made over to the State concerned in whose territory such administration may have been assumed.

2nd.—Complete impartiality in the distribution of the water among the villages along the Canals, so that the British villages and those of other Native States shall, if required, share the water equally with the villages of the States concerned; also an equal administration of justice to all persons over whom the Officers of the States concerned may exercise jurisdiction, so that the subjects of the British Government or of any Native State shall be dealt with according to the same principles of law as are respected by the Officers of the British Government.

3rd.—Ready and friendly compliance on the parts of the Governments of the States concerned with those requests of the Punjab Government and its Superior Officers who have chief charge of the Irrigation Department in the Punjab which shall be declared by them to be essential for the proper maintenance and satisfactory working of the canals as a whole.

The Governor-General in Council will at all times be ready to receive any representation from the Government of any of the States concerned, if that Government considers that the spirit of the present proposals are from any cause not fully acted up to by the Officers of the Punjab Government on whom the immediate duty of carrying them out will devolve.

Executed at Umballa, this Eighteenth Day of February 1873.

(Signed) GORE OUSELEY,

Commissioner, Umballa Division.

والہ موہر سنگھ رام دیال مہر منشی سردار بشن سنگھ حاکم عدالت - راجہ عالی ناہی
خانیہ سید محمد حسن مہر منشی سرکار سوری مہاراجہ صاحب مہندر بہادر بالقابہ والی پٹیالہ

(Signed) NORTHBROOK.

Seal

(True Copy.)

(Signed) H. R. COOKE,

Registrar, Foreign Department.

Ratified by His Excellency the Viceroy and Governor-General of India, at Calcutta, on the Twenty-Sixth Day of March 1873.

(Signed) C. U. AITCHISON,

*Secretary to Government of India,
Foreign Department.*

APPENDIX F-2.

Final Working Agreement of Sirhind Canal between the Imperial Government
and the Signatory States.

CONVENTION AND WORKING AGREEMENT.

Details of superintendence, powers of local officers, and other matters connected with the management of the main channels of the Patiala Branches, Sirhind Canal, and their connected works, which require to be settled by the Punjab Government with the States concerned, subject to the confirmation of the Supreme Government under clause 27 of the Terms of Agreement of 1875 regarding the Sirhind Canal.

1. The Patiala Branches of the Sirhind Canal and their connected works will form one Executive charge hereinafter called the Patiala Division, Sirhind Canal, and the Establishment of the said Division will, as laid down in clause 25 of the Terms of Agreement, work entirely under the orders of the British Government.

2. The Division will comprise two Sub-Divisions, as under—

1st Sub-Division.

First Feeder	...	...	...	...	15 miles.
Kotla Branch	...	...	...	...	97 „
Total					112 „

2nd Sub-Division.

Second and Third Feeders	...	...	...	...	25 miles.
Patiala Navigation Channel	...	...	...	...	7 „
Ghaggar Branch	...	...	...	...	54 „
Choa Branch	...	...	...	...	25 „
Total					111 „

3. The Establishment to be employed in the Patiala Division will be of the strength shown in the appended Schedule, which is estimated to cost Rs. 3,175 (three thousand one hundred and seventy-five) per mensem at the average rates of salary adopted in the Schedules of Establishment for the Irrigation Department of the Punjab. The actual cost will vary with the grades of the Officers employed. Travelling allowances and contingent expenses will be an additional charge. The strength of the Establishment may be altered from time to time by the British Government in accordance with requirements, and the actual cost will be borne by the Signatory States in the proportions of their respective shares, *viz.*—

Patiala	...	...	...	...	83.6 per cent.
Nabha	...	...	...	...	8.8 „
Jind	...	...	...	...	7.6 „

Further charges will also be made to the States on account of Direction and Leave and Pension Allowances which will be calculated in accordance with the general rules for the time being in force for regulating the distribution of such charges.

4. The limits within which the Establishment of the Patiala Division will work upon the Patiala Branches, are the boundaries of land taken up for the said Branches and their connected works. Within these limits the provisions of the Canal Act, which may for the time being be in force in the Punjab, will be held to apply, and offenders against Canal regulations will be treated in accordance with the provisions of clause 28 of the Terms of Agreement for the Sirhind Canal.

5. The Officers of the Patiala Division will also have power to enter on land outside the limits or boundaries of the Patiala Branches in case of any accident happening or being apprehended to any of the said Branches or their connected works, and to execute all works which may in their opinion be necessary for the purpose of repairing or preventing such accident. Compensation will in every such case be tendered to the proprietors or occupiers of the said lands for all damages done to the same; and if such tender be not accepted, the matter will be referred to the State which owns the said lands, in order that compensation may be awarded in accordance with clause 7 of the Terms of Agreement for the Sirhind Canal.

APPENDIX F-2.

6. The officers of either of the Signatory States will in like manner have power to enter on lands outside the limits or boundaries of any Distributary owned by such State in case of any accident happening or being apprehended to the said Distributary, and to execute all works which may be necessary for the repair or prevention of such accident, whether the lands in question belong to the British Government or to any other Signatory State. Compensation will in every such case be tendered to the proprietors or occupiers of the said lands for all damages done to the same; and if such tender be not accepted, the matter shall be referred to the British Government or to the State concerned, as the case may be, for disposal in accordance with Article 7 of the Terms of Agreement.

7. In order to ensure the distribution of the available supply in proportion to the respective shares of the Signatory States, and to guard against breaches in the lower portions of the Branches which would result from the sudden closure of the Upper Distributaries the entire control of the supply entering the heads of the Patiala Branches will rest with the Officers of the Patiala Division, provided that the control of the supply entering the head of any Distributary may, with the approval of the Local Government, rest with the State to which the Distributary belongs, if it be known that the State possesses such an Establishment as will enable it to satisfactorily comply with the following indispensable conditions:—

- (a) The supply in the Distributary shall never exceed a certain maximum gauge which will be determined from time to time by the Executive Engineer, Patiala Division.
- (b) During periods of insufficient supply the Distributary shall be closed completely and so as to avoid leakage at the head for such periods as may be prescribed by the Executive Engineer, Patiala Division.
- (c) In the event of a breach in the Distributary or of a sudden cessation in the demand, the supply entering the head shall not be shut off to such an extent as may cause a rise of the supply on the Canal gauge next below the head of the Distributary in excess of the limit which may be from time to time prescribed by the Executive Engineer, Patiala Division. Should a further reduction of the supply be required, the person in charge of the regulation shall report at once to the nearest Canal subordinate, and await his instructions or a lowering of the supply.
- (d) The person in charge of the regulation of the supply to a Distributary shall maintain a correct record of the gauges in the head reach of the Distributary and of the Canal gauges in the vicinity, when these are not recorded by a servant of the Executive Engineer's Establishment. Copies of the gauge registers shall be sent daily to the Executive Engineer, and the register shall be at all times available for the inspection of the Executive Engineer and his subordinate officers.

8. If the regulation of the supply entering a Distributary be not carried on in strict accordance with the conditions prescribed in the preceding article, the Executive Engineer, Patiala Division, will at once report the matter to the State concerned, and if the State fail to notice his representation or to make satisfactory arrangements for more efficient regulation, the Executive Engineer shall resume the regulation of the supply to all the Distributaries owned by the State concerned, or to as many of them as he may consider necessary. In all such cases a report of the circumstances shall be made by the Executive Engineer to the Chief Engineer, through the Superintending Engineer of the Circle. The orders of Chief Engineer shall be final, and in the event of the Executive Engineer's action being confirmed the control of the supply to the Distributaries concerned shall not be restored to the State without his permission.

9. The requirements of the States in each of their respective Distributaries will be communicated to the Executive Engineer, Patiala Division, at suitable intervals in the form of a requisition or indent, stating the depths of water and corresponding supplies required at the head of each Distributary. If sufficient water be available, the Executive Engineer will pass into each Branch the full supply required to meet all indents in full. If the supply be insufficient, he will either reduce the supplies or depths asked for in each Branch, so as to give to each its proper share of the actual supply, or he will arrange to close or reduce the supply to one or more Branches for a suitable interval, and in rotation so as to run the others with the full supply indented for, or as near to the indent as may be practicable. The method to be adopted in the distribution of the supply between the Branches will depend on the exigencies of the irrigation and the wishes of the States concerned, which the Executive Engineer will consult as far as possible.

10. When the supply available is not sufficient to meet all indents in full, the Executive Engineer will scrutinize the indents submitted by each State, and when necessary will make such a reduction in the aggregate indent of either of them as may bring it within the limit of the established proportion of the available supply to which it is entitled, viz:—

Patiala	...	...	...	...	83.6	per cent
Nabha	...	...	...	...	8.8	"
Jind	...	...	...	...	7.6	"

in the same manner as laid down in clause 20 of the Terms of Agreement for the distribution of supplies between the British and Patiala Branches.

APPENDIX F-2.

11. Reductions of indents under the preceding articles will not, as a rule, be made in the quantity of water applied for in particular Distributaries (except when these quantities will cause an excess of the maximum permissible gauge), but in the time during which the Distributaries shall be permitted to remain open. Thus if the aggregate indent of a State amounts to 200 cubic feet for a period of ten days and the supply available will allow 160 cubic feet only, the Distributaries may be run to the full extent of the indent for eight days, and closed during two. The Executive Engineer will determine and intimate to the States the necessary durations of such closures.

12. The distribution of the supply for each indent period must be settled on its own basis, and the fact of a State having indented for less than its full share in previous periods will not entitle it to more than its due share in a given period. Similarly, if a State does not take its full or sanctioned share in any day of a period, it will not on this account be entitled to more than its share on any other day during the same period.

NOTE.—This article relates only to cases in which a State has not taken on a particular day or for a particular period the full gauge allowed by the Executive Engineer. It will not affect the arrangement of closures ordered by the Executive Engineer, under which a State may be given less than its share for one day or period and more than its share for a subsequent day or period.

13. The Executive Engineer, Patiala Division, will as soon as possible after the receipt of an indent, inform the State concerned of the orders passed thereon, and of the reasons for any modifications or reductions. In such orders the particular days or periods during which closures of particular Distributaries are to be enforced should be clearly stated.

14. The gauge registers for the heads of the several Distributaries will be held to give authoritative data for calculating the quantity supplied to them, subject, however to such tests and verification as the Executive Engineer may deem necessary.

15. These gauge registers will be carefully maintained in bound books by the Executive Engineer, Patiala Division, and will show for each day—

- (a) The gauge indented for and that allowed by the Executive Engineer on the State indent, when the indent has been modified.
- (b) The actual gauge-readings in the Branch and in the Distributary immediately above and below the head of the Distributary, and in all cases in which the heads have been supplied with gates and rack gearing, the actual height of the gate opening.
- (c) The volume discharged.
- (d) The reasons for the allowed indents not being complied with in full.

At the close of each month the daily discharges will be totalled.

16. In another bound book the total discharges of the Distributaries for each month will be abstracted and compared with the total or daily discharges at the head of the Patiala Branch (First Feeder) and with the discharge to which each State would be entitled at the established proportion, after deducting for loss in the Branches. For this purpose the Distributaries belonging to each State will be grouped together, and the aggregate of their discharges shown. Differences between the actual discharges and those calculated on the established proportions will be duly explained.

17. A copy of this monthly abstract will be sent by the Executive Engineer, Patiala Division, to the Superintending Engineer of the Circle as soon as possible after the close of each month, and it will be the duty of the Superintending Engineer to scrutinize these returns carefully, and to satisfy himself that the principle of proportionate distribution is attended to by the Executive Engineer. The Executive Engineer will also send a copy to each of the Signatory States if requested to do so.

18. Complaints on the part of a Signatory State regarding the distribution of water will be addressed to the Superintending Engineer of the Circle and sent through the Executive Engineer, Patiala Division, who, in forwarding the complaint, will attach his explanation to it. The Superintending Engineer will communicate his decision on the subject to the State and an appeal will lie to the Lieutenant-Governor of the Punjab under clause 43 of the Terms of Agreement.

19. The Officers of the Patiala Division will have power to observe discharges in the Distributaries of the Signatory States, and to do all things needful to ascertain the volumes of water passing into the said Distributaries. The States to whom the Distributaries belong will be bound to provide funds for the construction of discharge sites, gauges, and any other works which the Executive Engineer, Patiala Division, may consider necessary for the actual measurement of the said discharges.

APPENDIX F-2.

20. The Signatory States will be bound to make arrangements for the supply of labour for urgent works, delay in the execution of which would endanger the safety or efficiency of the Patiala Branches. The names of the villages which are to supply labour, the number of labourers to be supplied by each village, the names of the responsible persons who shall be addressed when labour is required to be collected, the rate of wages, and other details will be settled by the States in communication with the Superintending Engineer of the Circle, and the arrangements will be such as will ensure the labour being promptly supplied on the requisition of the Executive Engineer of the Patiala Division, or of the Sub-Divisional Officers.

21. British villages commanded by the Distributaries of a Signatory State will be entitled to a share of the supply sufficient for the irrigation of the same percentage of the area commanded as may be allowed in other villages on the same Distributaries, subject to the following conditions :—

- (a) The regular payment of all charges for water supplied, whether for irrigation or other purposes, subject to the conditions of Article 23 of this Convention.
- (b) The due observance of such rules and regulations for the distribution of the supply, maintenance of water-courses, etc., as may be made by the State, and are in accordance with the Canal Act and Rules passed under it.
- (c) Abstention from wilful or malicious damage to the State Distributary or its connected works, or from interference with the officers or servants of the State in the discharge of their legitimate duties.
- (d) The supply of a fair and reasonable number of labourers in the event of a breach of the banks of the Distributary or other accident within the boundaries of the villages concerned.

In the event of either of these conditions not being fully complied with, the State owning the Distributary may make a representation on the subject to the Executive Engineer, Patiala Division, who will at once proceed to enquire into the matter and will pass such orders as may be appropriate. Cases of offences under Section 70 of the Canal Act will be tried by the Executive Engineer in his capacity as a Canal Magistrate under that section.

In the event of a general or persistent disregard of the above conditions the State concerned may, after communication with the Executive Engineer, reduce or withdraw the supply assigned to the village in question, provided that the supply shall not be reduced or withdrawn during the currency of a crop, and that no outlet shall be closed or removed for a longer period than one year or two harvests without the concurrence of the Local Government.

22. The Executive Engineer will be the medium for all communications on matters relating to the canal between the States and the British villages irrigated from the Patiala Branches. The States will address him when they find reason to complain regarding the action of the villagers, and he will take such action as may appear necessary in each case, keeping the States informed of the final orders passed by him. Similarly, complaints on the part of the villagers will be addressed to him, and he will, after due investigation, send on to the States concerned cases which appear to require action on the part of the State; the final orders passed by the State in each case will be communicated to him.

23. The charges for water supplied to British villages from the Patiala Branches, whether for irrigation or for other purposes, are not to exceed the charges which are leviable under the schedule of rates in force on the British Branches for water supplied from those Branches to villages of the British and Signatory States. The Superintending Engineer of the Circle will supply each State with a schedule of the rates in force on the British Branches for irrigation from Canals and Escapes, and for supply of water for other purposes, and will communicate any alterations in the said schedule that may from time to time be sanctioned by the British Government.

24. The Executive Engineer, Patiala Division, will be the sole agent through whom the sums due from British villages irrigated from the Patiala Branches are to be recovered, and the States will refrain from attempting to collect money direct from the inhabitants of British villages, except as provided in Article 26 of this Convention.

25. The procedure for the recovery of water-rates on account of irrigation in British villages from the Patiala Branches will be as follows :—

- (a) If the measurements of the land irrigated are made by the officials of a Signatory State, it will be the duty of these officials to inform the Executive Engineer, Patiala Division, of the dates on which the measurements will be made. The Executive Engineer, Patiala Division, will then give due information to the Deputy Commissioners of the districts concerned, who will issue orders to the Lambardars and Patwaris to attend the measuring parties,

APPENDIX F-2.

On completion of the measurements the officials of the State will hand over the "parchas" to the Lambardars for distribution to the villagers and make out the Demand Statements, which will be forwarded through the Executive Engineer, Patiala Division, to the Deputy Commissioners of the districts concerned, who will collect the revenue as assessed.

- (b) The villagers may lodge any complaints within the prescribed period either with State officials or with the Executive Engineer, Patiala Division, or with the Deputy Commissioner. The two latter officers will forward any objections so received to the State for due inquiry. If remissions be granted, the State officials will forward the usual Remission Statements, through the Executive Engineer, Patiala Division, to the Deputy Commissioner, who will take the necessary action. The amount due as fees to Lambardars which shall equal 3 per cent. on the amount to be collected, will be shown on the "Khataunis" which will be forwarded through the Executive Engineer, Patiala Division, to the Deputy Commissioner. The Deputy Commissioner will, after making the necessary deductions on this account, remit the balance of the demand to the several States concerned.

No retrenchment will be made by any Signatory State from the amounts due as fees to Lambardars on account of non-fulfilment of the conditions laid down in Rule 37, passed under Act VIII of 1873, but the State will duly report to the Deputy Commissioner, through the Executive Engineer, Patiala Division, cases in which those conditions have not been complied with to its satisfaction, and the Deputy Commissioner will take such action as he may consider necessary, of which the States concerned will be duly informed.

- (c) The Executive Engineer, Patiala Division, will, if requested to do so by a Signatory State, undertake to record and measure the irrigation in British villages from the Patiala Branches, subject to such conditions as regards payment by the State of the cost of the establishment required and other matters as may be approved by the Punjab Government.

- (d) The Punjab Government reserves to itself the right of deputing Patwaris to attend the State measurements in British villages irrigated from the Patiala Branches, who will take a copy of the State Khasra or Measurement Paper, will make out the Demand Statements and prepare and distribute the "parchas." In this case the procedure prescribed in clauses (a) and (b) will be so far modified that the State officials will not make out the "parchas" or the Demand Statements, but will merely forward to the Deputy Commissioner through the Executive Engineer, Patiala Division, an abstract of the demand, or "Jamabandi" for each village, while in addition to the deduction for Lambardars' fees of 3 per cent. on the amount to be collected, a further deduction of 2 per cent. will be made for the remuneration of the Patwaris employed.

26. Demand Statements for the recovery of charges other than water-rates from British villages irrigated from the Patiala Branches will be sent by the States to the Executive Engineer, Patiala Division, who, after satisfying himself of their correctness, will forward them to the Deputy Commissioner of the District concerned for realization, provided that in cases in which the villagers do not dispute the claim, they shall be permitted to pay such demands to the officials of the State concerned. All amounts collected by the Deputy Commissioner on account of charges other than water-rates shall be remitted to the Signatory States concerned in the same way as provided in the case of water-rates.

27. The Signatory States will, after the close of each year ending 31st March, forward through the Political Agent, Phulkian States, to the Superintending Engineer, Sirhind Canal, for inclusion in the Annual Revenue Report of that Canal, statistical returns showing the working of the Distributaries of the Patiala Branches, during the past year in the respective States.

The returns will be in such forms, will contain such information, and will be forwarded on such dates as may from time to time be prescribed by the Punjab Government. In like manner the Punjab Government will forward to the Signatory States similar returns and annual reports relating to the British Branches and Distributaries.

28. The foregoing stipulations will remain in force until modified or added to with the consent of the Punjab Government on the one part, and the Signatory States concerned on the other part. It will be open to the Punjab Government and to any one or more of the Signatory States to propose such modifications and additions as may from time to time be found desirable, provided that they shall be binding only on the assenting parties and shall not be prejudicial to the interests of any non-assenting Signatory State.

APPENDIX F-2.

Schedule showing establishment to be employed in the Patiala Division, Sirhind Canal, referred to in Article 3 of the Working Agreement of the Sirhind Canal between the Imperial Government and the Signatory States.

Rank.	Number.	Rank.	Number.
Executive Engineer ...	1	Sowars ...	2
Sub-Engineers ...	2	Duffadars ...	3
Sub-Overseers ...	8	Barkandazes ...	16
Accountant ...	1	Jamadar ...	1
Clerks ...	7	Peons ...	6
Draftsman ...	1	Watchmen ...	34
Hospital Assistants ...	3	Dak Runners ...	36
Signallers ...	8	Hospital Coolies ..	3
Mistri ...	1	Bhishtis ...	2
Gauge readers ...	4	Sweepers ...	5

WITNESSES :

- (Sd.) GOKAL CHAND,
*Deputy Foreign Minister,
Patiala State.*
 - (Sd.) SUNDER SINGH (in Ver.),
Assistant Foreign Minister.
- JIND STATE.

(Sd.) ABDUL MAJID KHAN, Col.,
Foreign Minister, Patiala State.

WITNESSES :

- (Sd.) UMRAO BEG (in Ver.),
Ahalkar-i-Ala, Jind State.
- (Sd.) BRIJ NARAIN (in Ver.),
Ahalkar-i-Ala, Jind State.

(Sd.) SHAMSHIER SINGH,
Ahalkar-i-Ala, Jind State.

WITNESSES :

- (Sd.) BISHAN SINGH (in Ver.),
Canal Agent, Nabha State.
- (Sd.) SALIG RAM, VARMA,
*Deputy Foreign Minister,
Nabha State.*

(Sd.) PARABH DYAL (in Ver.),
Foreign Minister, Nabha State

WITNESSES :

(Sd.) F. E. KANTHACK,
*Executive Engineer, Public
Works Department, Irrigation
Branch, Punjab.*

The 12th August 1903.

(Sd.) R. P. RUSSELL,
*Under-Secretary to Govern-
ment, Punjab, Public Works
Department, Irrigation
Branch.*

The 12th August 1903.

(Sd.) J. BENTON,
*Secretary to Government,
Punjab, Public Works
Department, Irrigation
Branch.*

The 12th August 1903.

APPROVED and confirmed by the Government of India.

FORT WILLIAM :

The 23rd February 1904.

By order,

(Sd.) LOUIS W. DANE,

*Secretary to the Government of India in the
Foreign Department.*

APPENDIX F-3.

Amended Terms of Agreement between the British Government and the State of Jind for regulating the supply of water for irrigation from the Western Jumna Canal executed at Simla on behalf of the British Government by C. L. Tupper, Esquire, Chief Secretary to the Government of the Punjab, duly empowered by His Excellency the Viceroy and Governor General in Council and at Sangrur on behalf of the Jind State by Sardar Rattan Singh, President, Council of Regency, duly empowered by His Highness the Raja of Jind.

The terms of agreement executed on the 29th April 1875 are hereby cancelled.

2. In lieu of the cuts from the Canal, by means of which irrigation was originally effected, ten main distributaries with proper masonry heads taking out of the Hānsi Branch of the Western Jumna Canal and four masonry heads for water-courses taking out of the Butāna Distributary shall be provided for the irrigation of the State from the Western Jumna Canal.

3. The said distributaries and the said water-course heads taking out of the Butāna Distributary shall be constructed at the cost of the British Government, but when completed shall be handed over to the Jind State, with the exception of the masonry heads and the portions of the channels within canal limits.

4. The distributaries so made over shall be kept in repair by the Jind State, a deduction being made on this account from the annual charge for water. The deduction shall be calculated at a certain rate for irrigated area fixed with reference to the average cost per acre for maintenance of distributaries elsewhere in British territories.

5. So soon as the ten main distributaries taking out from the Hānsi Branch are made over to the Jind State, the British Canal Officer shall thenceforth exercise no interference in regard to the internal management and the distribution of water from them; nor shall he, unless at the request or with the consent of the Jind Canal Officer, reduce the supply entering the heads, provided the full gauge readings specified in Article 7 be not exceeded; but the British Canal Officer shall have full power to shut off or to reduce the supply entering the Hānsi Branch under the following circumstances:—

- (a) As part of a general closure of the Western Jumna Canal for necessary or emergent repairs, of which due notice will be published in the *Punjab Gazette* for closures of more than ten days' duration.
- (b) For purpose of repairs to any canal work or for usual or necessary silt clearances on the Hānsi Branch.
- (c) On occasions of excessive rainfall or general reduction of the demand for canal water, that may render a reduction of the supply necessary, either for the safety of the canal banks or works, or to prevent undue flooding or waste of water.
- (d) For the purpose of a more effective distribution of the supply available for the distributaries on the New Main Line, and for the Delhi and Hānsi Branches and the Butāna Distributary, all closures and reductions of the supply to the Hānsi Branch being as far as possible compensated for by an immediately previous or subsequent increase of the supply which would otherwise be due to that Branch.
- (e) In the event of the supply available for the distributaries on the New Main Line and for the Delhi and Hānsi Branches and Butāna Distributary falling below the demand, in which case the supply to the Hānsi Branch shall either be rateably reduced or shall be regulated as provided in clause (d) of this Article. As long previous notice as possible shall be given to the Jind Canal Officer of all closures or reductions of the supply ordered under clauses (a), (b), (d) and (e).

Immediate notice of all closures or reductions of the supply ordered under clause (c) shall also be given to the Jind Canal Officer, who will be consulted as to the length of the period during which the reduction of the supply should be maintained.

6. The British Canal Officer shall have full power to shut off or reduce the supply to the Butāna Distributary at his discretion in accordance with the exigencies of irrigation, and the outlets provided on that distributary for the irrigation of Jind territory shall be subject to such periodical and special closures as may be ordered from time to time for British outlets in accordance with Rule 15, passed under Act VIII of 1873, due intimation of such orders being given to the Jind Canal Officer, but no closure shall be ordered on account of alleged wastage of water owing to disrepair of irrigating channels.

7. The distributaries shall be constructed of sufficient capacity, when running to a full gauge, to irrigate in combination with the four water-courses, from the Butāna Distributary, an aggregate area of 60,000 (sixty thousand) acres per annum; but in order to compensate for all irregularities or deficiencies in the supply passed into them, the annual

APPENDIX F-3.

charge for the water supplied shall be calculated on an irrigated area of 50,000 (fifty thousand) acres only, and no claims shall be raised by the Jind State for reduction of such annual charge on the grounds of short supply.

8. Gauges shall be placed at the head of each distributary for the determination of full supplies, the zero of the gauge in each case being placed on the level of the bed of the distributary. The following gauge readings shall be held to represent full supplies in the case of each distributary :-

Number of Distributary.							Full supply gauge reading.
I	...	...	...	...	...	...	4.0
II	...	...	...	...	...	...	2.0
III	...	...	...	...	...	...	3.5
V	...	...	...	...	...	...	3.5
VI	...	...	...	...	...	...	2.0
VII	...	...	...	...	...	...	4.5
VIII	...	...	...	...	...	...	4.0
IX	...	...	...	...	...	...	3.5
X	...	...	...	...	...	...	3.5
XI	...	...	...	...	...	...	3.0

NOTE—No IV is a branch of No. III and has no separate head in the Canal.

No. I Distributary having been constructed to carry double the full supply sufficient for the irrigation of the area dependent on it, shall be closed at the head during every alternate week or other convenient interval of time, and shall be opened in the corresponding alternate intervals. The remaining nine distributaries shall be allowed to run constantly, subject to temporary closures of the Hānsi Branch under Article 5 of this Agreement. Every distributary when open shall be entitled to as full a supply as the supply in the Hānsi Branch will permit without being headed up, provided that the above-mentioned gauge readings shall in no case be exceeded.

8. (a) The heads of all the Jind Distributaries shall remain under the sole control of the British Canal Officer, who will arrange for the maintenance of the supply in each at the gauge indicated for by the Jind Canal Officer, if not in excess of the full supply gauge reading prescribed in Article 7, and as far as the available depth of water in the Hānsi Branch will permit. In the event of a breach or sudden cessation of the demand on a Jind Distributary, the supply entering at the head shall not be reduced except in accordance with the general or special orders in this regard that may be issued from time to time by the British Canal Officer, but all reductions of supply applied for by the Jind Canal Officer will be effected after due and sufficient notice has been given.

9. Masonry diaphragms shall be constructed in the first two miles of each distributary which shall be held to indicate the normal bed levels and cross sections of the channel in which they are situated. The Jind State shall make all clearances of these channels as nearly as may be in conformity with the levels and cross sections thus indicated, and shall not increase the capacity of any of the channels beyond the limits indicated by the said diaphragms without the consent of the British Government. The British Canal Officers shall be at liberty to inspect the said diaphragms and to repair them at the cost of the British Government should they be found to require it.

10. The amount payable annually by the Jind State for the supply of water for irrigation shall be calculated on an area of 50,000 (fifty thousand) acres, the rate per acre being the average of some few years of measured irrigation in lands similarly situated in British territory, but the amount shall be subject to deduction on account of—

- (1) cost of repairs and maintenance of distributaries as provided in Article 4 ;
- (2) reduction of canal establishment resulting from transfer of sole management of the distributaries to the State ;
- (3) fees to lambardars and patwaris at the rate of 5 (five) per centum on the amount payable.

APPENDIX F-3.

NOTE.—The net amount payable by the State, after making the stipulated deductions, has been fixed for the present at Rs. 1,05,500 (one hundred and five thousand five hundred) as detailed below. The rate of 2·4 (two and four-tenths) rupees per acre was obtained by striking a mean for five years ending 1883-84 of actual realizations per acre irrigated in the Jind State:—

<i>Gross sum payable—</i>				Rs.
50,000 acres at Rs. 2·4 per acre	...	...	...	1,20,000
<i>Deductions—</i>				Rs.
(1) Maintenance and repairs	...	...	...	5,000
(2) Establishment savings	...	...	...	3,500
(3) Fees to lambardars and patwaris	...	...	...	6,000
				<hr/> 14,500
Net amount payable per annum				<hr/> 1,05,500 <hr/>

11. In the event of there being a general reduction of water-rates on the canal, a rateable reduction shall be made in the amount payable by the State; and in the event of the rates being increased, a rateable increase shall be demandable from the State.

12. In case of any difference of opinion arising between any officers of the Jind, State and the British Canal Officers relating to the supply of water it shall be referred to the Lieutenant-Governor of the Punjab, whose decision shall be final. If any difference of opinion shall arise between the Jind State and the Lieutenant-Governor of the Punjab as to the construction of this agreement, a reference may be made to the Governor-General in Council whose decision shall be final.

Executed at Sangrūr this twenty-fourth day of July 1892, on behalf of His Highness the Rāja of Jind, by Sardār Rattan Singh, President, Council of Regency, in presence of me Lāla Chandu Lāl, Mīr Munshi.

(Sd.) C. L. TUPPER,

Dated 10th August 1892.

Chief Secretary to Government, Punjab.

Approved and confirmed by His Excellency the Viceroy and Governor-General of India.

FOREIGN DEPARTMENT, }
SIMLA :
The 16th September 1892. }

(Sd.) H. M. DURAND,

Secretary to the Government of India.

APPENDIX F-4.

AMENDED.

Draft Agreement between the British Government and the Patiala State,
regarding the Sirsa Branch of the Western Jumna Canal.

	Sirhind Canal Agreement No	Remarks by Superintending Engineer.
<p>1. The entire project to be carried out under the exclusive control of the British Government on the general basis of taking a supply of water in the most economical manner from the Western Jumna Canal above the Indri Regulator to those portions of the Kaithal Tahsil of the Karnal District, the Nirwānah Parganah of the Patiala State, and the Fatahabad and Sirsa Tahsils of the Hissar District, to which it can, from an engineering point of view, be most advantageously carried.</p>	1	
<p>2. The original designs for the Canal works, including all Distributaries, shall be prepared and carried out under the sole direction of the British Government, every possible attention being given to the wishes of the Patiala State, as to the precise direction and position of the channels traversing its territory, consistently with sound engineering principles.</p>	2	<p>The words "<i>prepared and carried out</i>" having been substituted for "<i>drawn out</i>" in corresponding Article of Sirhind Canal Agreement. With this modification Article 24 of Sirhind Canal Agreement will not be required, as the whole ground is covered by this Article 2.</p>
<p>3. On the completion of the detailed surveys for all Distributaries the British and Patiala shares of the water-supply available shall be determined on the general basis of the proportions of the areas commanded by the entire system in British and Patiala territory, respectively.</p> <p>NOTE.—In this and subsequent Articles the term "commanded area" shall be held to mean the areas that can be naturally and conveniently commanded.</p>	3	<p>This Article determines the shares of water due to Patiala territory for purposes of Article 8, but not the share that will be actually due to Patiala Distributaries, which will be governed by Article 25.</p> <p>In the General Project Estimate the areas commanded in British and Patiala territories* have been estimated at 919 and 355 square miles, respectively, under which proportion Patiala would be entitled to $\frac{355}{1274} = 28$ per cent. of the total supply available. This percentage may, however, be liable to some modification when more detailed surveys have been completed.</p>
<p>4. In the subsequent parts of this Agreement the upper portion of the Sirsa Branch Canal, from its head above Indri to the point at which it first enters Patiala territory, will be called the First or British Upper Section, which will also include any escape that may be constructed, irrespective of the territory in which its head is situated; the portion from the point where the Canal first enters to the point where it finally leaves Patiala territory will be called the Second or Patiala Section; and the remainder of the Branch will be called the Third or British Lower Section. Also the Distributaries which may be designed solely or mainly for the irrigation of Patiala territory, whether their heads be situated in a British or Patiala Section of the Branch, will be called Patiala Distributaries, while all other Distributaries will be called British.</p>	4	<p>As any Escape that may be constructed will be for the common benefit of both States, the cost must be included in that of First Section, of which Patiala will bear a full share, in the proportion given by Article 3.</p> <p>As it will be unavoidable that at least one of the Patiala Distributaries should irrigate portions of British territory, the words "or mainly" have been introduced in this definition.</p>

Sirhind Canal Agreement No.	Remarks by Superintending Engineer.
<p>5. Every effort will be made to so design all the British and Patiala Distributaries so as to exclusively irrigate British and Patiala Territory, respectively; but whenever a departure from this principle may be necessitated by the physical configuration of the country, or by other engineering considerations, water shall be distributed from both the British and Patiala Distributaries, rateably, to all villages along their courses whose lands can be advantageously irrigated therefrom, whether such villages be under the jurisdiction of the British or the Patiala Government.</p>	<p>It has been found absolutely obligatory that the Sudkan Rājbaḥa which will be the principal Patiala Distributary, should take out 10 miles above the Patiala boundary, and traverse 10½ miles of British territory, which will require irrigation. On the other hand, two British Rājbaḥas (the Habri and the Pabra) are likely to traverse and irrigate small portions of Patiala territory. These are the only exceptions contemplated at present to the territorial principle, but it is quite possible that other cases may occur.</p>
{ 5 } { 6 }	
<p>6. The land required for the Canal and works in connection with it shall be made over by the Patiala Government according to its own usage, all payments of compensation being made by the British Government in accordance with the procedure that has been observed in the payment of compensation for land made over by the Patiala Government for the purpose of the Sirhind Canal, and the amounts so paid being dealt with as a part of the general expenditure on the Canal works.</p>	<p>7 The procedure on Sirhind Canal has worked smoothly and satisfactorily, and should be continued.</p>
<p>7. Compensation will be paid for any building or house injured by the works.</p> <p>8. The entire cost of the First or British Upper Section of the Sirsa Branch, exclusive of Distributaries, but inclusive of original surveys and the preparation of the project, and also of such additions to and improvements of the Head Works and Main Line of the Western Jumna Canal, as may be rendered necessary by the increase in the supply required for the Sirsa Branch, shall be borne by the British and Patiala Governments in the proportion of the water-supply finally allotted to each under Article 3 of this Agreement.</p>	
<p>The entire cost of the Second or Patiala Section, exclusive of Distributaries, shall be borne by the British and Patiala Governments according to the proportions of their respective commanded areas, after deducting from the British area the area commanded in British villages situated in the First Section.</p>	<p>8 The entire cost of the Third or British Lower Section shall be borne by the British Government.</p>
<p>The entire cost of the Third or British Lower Section shall be borne by the British Government.</p>	
<p>9. The entire cost of the British Distributaries will be borne by the British Government, and that of the Patiala Distributaries by the Patiala Government.</p>	<p>9 According to the Project Estimate the Patiala shares of the First and Second Sections will be 28 and 41·2 per cent, respectively, the calculation being made as provided in this Article. The absolute amount of the Patiala share of First Section is therefore estimated at Rs. 4,86,202, while that of the Patiala share of Second Section, excluding Distributaries, may be taken at Rs. 1,81,610, so that the total liabilities under this Article, as at present estimated, will amount to Rs. 6,67,812.</p>
<p>A Branch or Minor Distributary taking off from a Main Distributary belonging to one Government for the purpose of exclusively irrigating the territory of the other Government shall be constructed and subsequently maintained at the cost of the Government whose territory will be exclusively served by it.</p>	

APPENDIX F-4.

	Sirhind Canal Agreement No.	Remarks by Superintending Engineer.
<p>10. The Patiala State shall supply annually, to meet the cost of construction while the works are in progress, such sums as may be estimated by the British Government as approximately equivalent to the share of the outlay of the year, which will be ultimately chargeable to the State under the terms of Articles 8 and 9 of this Agreement.</p>	10	<p>In the Project Estimate the cost of the Patiala Distributaries, including Establishment and Tools and Plant charges, has been estimated at Rs. 4,42,205.</p> <p>This clause is new, but required. Several cases may occur in which a purely territorial Minor may be made for the service of the State which does not own the Main Distributary and it is unreasonable to require the latter State to pay the cost either of construction or maintenance.</p>
<p>11. On completion of the works, an account will be drawn out by the British Government of the actual expenditure incurred on the different portions of the project, and a final statement will be prepared of the exact sum due from the Patiala State, which will then pay or receive back any difference between its actual payments year by year and its ultimate share of the cost.</p>	11	
<p>12. The above account of total cost will include the charges for the original surveys, and proper charges on account of Establishment, &c., whether incurred by the British or Patiala Government, and credit will be given to the Patiala State for all payments made by it directly.</p>	12	
<p>13. Copies of such parts of the British accounts of the expenditure on construction will be furnished periodically to the Patiala State as may be desired by it.</p>	13	
<p>14. The British Government shall have at all times the sole right of determining and controlling the supply to be passed into the Sirsa Branch Canal, due regard being paid to existing or established interests on the other portions of the Western Jumna Canal.</p>	14 New.	<p>This provision is necessary, and should be very clearly understood by the State.</p>
<p>15. Subsequent to the admission of water, the management of the entire length of the Sirsa Branch (but not of the Patiala Distributaries, except as provided in Articles 21 and 22) shall remain entirely in the hands of the British Government, but all expenses of maintenance of the Branch, Distributaries and connected works shall be shared by the British and Patiala Governments as provided in the next following Articles of this Agreement.</p>	25	
<p>16. The annual charges for the maintenance of the First, Second and Third Sections (not including Distributaries) and the corresponding incidental charges for Establishment and Tools and Plant, but not those for general direction, shall be borne by the British and Patiala Govern-</p>	{ 25 } { 3p }	<p>It is not proposed to distribute Working Expenses by Sections in the manner and proportions provided in respect of the Capital Expenditure in Article 8. This would involve the maintenance for all time of separate accounts of Receipts and Charges for each of the three Sections.</p>

APPENDIX F-4.

	Sirhind Canal Agreement No.	Remarks by Superintending Engineer.
<p>ments in the same proportions as those in which the final Direct Capital Charges on account of these Sections (not including Distributaries) may be ultimately distributed between the two Governments; but all charges for the annual maintenance of Patiala Distributaries shall be borne exclusively by the Patiala Government, except as provided in articles 21 and 22 of this Agreement.</p>		<p>which should be avoided if possible. It is therefore proposed to have a general Maintenance Account for the whole Branch, exclusive of Distributaries, and to follow the ultimate proportions of the Capital cost in distributing the total of the charges between the two Governments. Maintenance charges will be assumed as varying directly with the original cost, which is practically a fair assumption, and will greatly simplify future accounts.</p>
<p>17. Similarly, all Miscellaneous Revenue, <i>i.e.</i>, Revenue derivable from other sources than the supply of water for purposes of irrigation, that may be realized in the First, Second and Third Sections of the Sirsa Branch (not including Distributaries), will be credited to the British and Patiala Governments in the proportions of the ultimate distribution of the Direct Capital Outlay upon these Sections (not including Distributaries).</p>	38	<p>For the reasons given above, the principle of Article 16 must be also applied to receipts, separate account of which cannot be conveniently kept for each Section.</p>
<p>18. The Patiala State shall be entitled to all Revenue that may be assessed or assessable on account of irrigation or of sales of water for other purposes in Patiala villages, whether the water be supplied from British or Patiala Distributaries. Similarly, the British Government shall be entitled to all Revenue that may be assessed or assessable on account of irrigation or of sales of water for other purposes in British villages, whether the water be supplied from a British or a Patiala Distributary.</p>	New.	<p>The principle proposed is that each Government shall be entitled to the water-rates and owner's rates assessed in its own territory, irrespective of the ownership of the Distributaries from which irrigated. From an administrative point of view this arrangement is very desirable, and it is a necessary consequence of Article 8, under which the first cost is divided on the basis of territorial areas, and of Article 3, under which the supply to the respective territories will follow the same proportion.</p>
<p>19. With effect from the first day of April next after the date on which the first of the Patiala Distributaries is supplied with water, the Patiala State shall pay a share of the annual cost of maintaining the Headworks and Main Line of the Western Jumna Canal above Indri, and also of the annual general charges for Direction that may be debitable to the Revenue Account of the Western Jumna Canal. This share shall be determined annually by the British Government on the basis of the proportion of the actual or estimated area of irrigation in Patiala territory to the entire area irrigated on the Western Jumna Canal (including the actual or estimated Patiala area) that obtained in the year next preceding.</p>	{ 23 } { 39 }	<p>The principle of this Article is new, as, according to usual practice, the general charges to which it refers should be distributed between the Sirsa Branch and balance of Western Jumna Canal in proportion to the annual expenditure on works (<i>i.e.</i>, Extensions and Improvements and Maintenance and Repairs), and the Sirsa Branch quota distributed between the two Governments, under the provisions of Article 16. The resulting account would be exceedingly complicated, and could not be finally made until the accounts of the year had been entirely completed. A still greater objection to such an arrangement is that it would be inequitable. The Rabi supply on Sirsa Branch will vary greatly, according to seasons; in some years a considerable proportion of the supply available may be passed in the Branch, while in others it may be</p>
<p><small>NOTE.—For the purpose of this Article the actual area of irrigation in Patiala territory shall be taken as long as the Patiala Distributaries may, in accordance with the provisions of Article 21 of this Agreement, be controlled and administered by the</small></p>		

	Sirhind Canal Agreement No.	Remarks by Superintending Engineer.
<p>British Government; but after the Patiala Distributaries have been finally made over to the Patiala State, the area to be taken as that of Patiala Irrigation shall be estimated in the manner provided in Article 33. The entire area irrigated by the Western Jumna Canal shall also include the area in Jind territory, for which a fixed annual payment is made by the Jind State, in accordance with the agreement for the time being subsisting between the British and Jind Governments.</p>		<p>closed almost throughout the whole season. General charges should therefore be distributed, not according to expenditure incurred, but to benefits received that is, to the areas actually irrigated. It is advisable to take the area of the year preceding (the Rabi collections for which fall into the next year), so that the percentage of distribution may be determined for each year soon after its commencement, and the monthly accounts of expenditure adjusted accordingly.</p>
<p>20. The Patiala State shall not be entitled to any share in any Revenue realized on the Headworks or Main Line of the Western Jumna Canal, the whole of which shall be creditable to the British Government.</p>	37	<p>This Revenue is principally on account of Rattling dues and Plantations, the expenditure in connection with which, of which a share will be chargeable to the State under Article 19, is practically nil. As the State has not been called on to pay any share of the capital cost of Headworks and Main Line it is not entitled to any share in these receipts.</p>
<p>21. The Patiala Distributaries shall remain under the sole control and administration of the British Government for a period of five years dating from the commencement of the first crop to which water may be supplied from a Patiala Distributary. After the expiry of five years from the above date, the Patiala Distributaries shall be transferred to the control and administration of the Patiala State, provided that in the case of any Patiala Distributary of which the head is situated in British territory the British Government shall retain the control and administration of the portion lying between the head and the boundary of the Patiala State and shall bear the whole cost of the maintenance of such portion.</p>	New. 26 New.	<p>The proposal that the Patiala Distributaries should be worked on behalf of the State by the British Government for a period of five years, or until irrigation on them has been fairly developed, has been suggested by experience on Sirhind Canal. As the area that will be annually irrigated, even when irrigation is fully developed, is not likely to exceed 49,000 acres, it will hardly pay the State to employ a European Canal Officer in this isolated part of its territory, and it is thought, therefore, that this proposal will be readily accepted by the State.</p>
<p>In every case in which the upper portion of a Patiala Distributary may remain under the control of the British Government under this Article, a gauge shall be erected in the Distributary at or near the point at which it enters Patiala territory, and the British Canal Officer shall maintain such depths of water on the gauge (which shall be regularly recorded) as may ensure to the Patiala State its fair share of the supply.</p>		<p>The proposal to retain the administration and control of the upper portions of Patiala Distributaries when situated in British territory is to meet the case of the Sudkan Rajbaha, or any other similar case that may occur. The Patiala State will probably be very willing to accept this arrangement, as it finds difficulty in obtaining labour, &c., in British villages. As the first cost of the Rajbaha will be paid entirely by the State under Article 9, it is not unfair that the British Government, which will be strongly interested in it, should pay the cost of maintenance of this upper length, which will include silt clearance at head.</p>
<p>22. During the period that the Patiala Distributaries shall remain under the control and administration of the British Government, the Patiala State shall pay all charges incurred in respect of the maintenance and administration of such</p>	New.	

	Sirhind Canal Agreement No.	Remarks by Superintending Engineer.
<p>Distributaries, including a proportionate share of establishment, except those that may be incurred in respect of the maintenance and administration of any portions lying in British territory between the heads of the Distributaries and the Patiala boundary, which will be borne by the British Government under Article 21.</p>		
<p>23. The British Government shall arrange for the assessment of all Revenue in Patiala villages during the period that the Patiala Distributaries remain under its control and administration, but will forward the assessment papers to the Patiala State for realization of the amounts assessed.</p> <p>The rates of assessment during such period shall equal the combined occupier's and owner's rates that may be prescribed for British villages.</p>	New.	<p>The Revenue thus assessed will of course be creditable to Patiala State under Article 18.</p>
<p>24. After the Patiala Rājbahas have been transferred to the control and management of the Patiala State, each Government will conduct the assessment of the villages under its own jurisdiction, irrespective of the Distributaries from which water may be supplied to them, but in all cases in which a village under one Government is irrigated from a distributary belonging to the other, the Government owning the Distributary shall be entitled to a copy of the measurement papers.</p>	New.	<p>The condition proposed in latter part of this Article is necessary for completion of Divisional statistics, and so that the Government owning the Rājbaḥa may know whether any village has been getting more or less than its fair share of water.</p>
<p>25. The Patiala Distributaries shall be entitled to a percentage of the total supply entering the Sirsa Branch, which shall be equal to the percentage of the supply to which the Patiala State may be entitled under Article 3 of this Agreement, with such addition as may be necessary for the irrigation of any British territory that may be commanded by Patiala Distributaries, and with a proportional deduction on account of any area of Patiala territory that may be commanded by British Distributaries.</p>	New.	<p>Assume, as in the Project Estimate, that the Patiala share of the supply is 28 per cent., but that an area of British territory is to be irrigated from Patiala Distributaries for which an additional supply is required equal to 6 per cent. of that entering the Canal, and that British Distributaries will irrigate an area of Patiala territory, for which 2 per cent. of the whole supply will be required: then the percentage due to the Patiala Distributaries will be 28, <i>plus</i> 6, <i>minus</i> 2, or 32 instead of 28 per cent.</p>
<p>26. The supply entering the Sirsa Branch shall be held to be the supply passing a certain point in the First Section, situated above the head of the First British Distributary in that Section. The supply passed into the Patiala Distributaries shall be held to be the difference between the supply passing a certain point in the Sirsa Branch situated between the heads of the last British Distributary in the First Section and of the First Patiala Distributary, and the supply passing a certain point situated between the heads of the last Patiala Distributary and of the First British Distributary of the Third Section. The precise position of all three points shall be determined by the British Government.</p>	New.	<p>The supply entering the Canal will probably be gauged at Barthal, or in the 12th mile below the head, for reasons given in Superintending Engineer's Note on the question of loss by absorption as affecting the distribution of the supply. The supply entering the Patiala Section and Distributaries will be very accurately gauged above the proposed 9 feet fall in the 34th mile.</p> <p>The supply passing into the Third Section and its Distributaries will be gauged at a point not yet determined, but which will be at as short a distance as possible below the head of the last Patiala Distributary, probably near Nirwānah, in the 65th mile.</p>

APPENDIX F-4.

	Sirhind Canal Agreement No.	Remarks by Superintending Engineer.
<p>27. Gauges shall be fixed at the three points in the Sirsa Branch referred to in Article 25, and the registers of their readings shall be held to give authoritative data for the determination of the percentage of the whole supply entering the Branch which is passed into the Patiala Distributaries.</p>	21	
<p>28. The regulation of the water passing into the heads of the Patiala Distributaries shall be entirely under the control of the British Canal Officer in charge of the Sirsa Branch. The requirements of each Distributary will be communicated from time to time by an Agent appointed by the Patiala State for this purpose, and the British Canal Officer shall comply with these requirements, provided that they are within the limits of the supply to which the Patiala Distributaries may at the time be entitled under Article 25.</p>	New	<p>U distribution between the Patiala Distributaries of the full supply due to them as a whole will be effected in accordance with the instructions of the Patiala Canal Agent, to which full effect will be given, as long as they will not involve an excess over the total allotment.</p>
<p>But in seasons of short supply it shall be optional for the British Canal Officer to pass into the Patiala Distributaries an intermittent supply in excess of the percentage due to them, and to shut off the supply either partially or entirely during the intervening periods, provided that the aggregate supply passed into the Patiala Distributaries during a period of not more than fourteen days shall not, except with the consent of the Patiala Agent, or unless his indent is complied with in full, form a smaller percentage of the total supply entering the Sirsa Branch during the same period than will be due to them under the provisions of Article 25.</p>	New	<p>This provision is very necessary. During the Rabi especially, the Branch will very often run with supplies barely sufficient for more than one or two Rāj bahas, and a system of Rāj bahas tatils will be obligatory.</p> <p>Suppose the Patiala Distributaries to be entitled to 33 3 per cent., or one-third of the total supply. As long as Sirsa Branch is running its full supply of 1,200 cubic feet per second, the Patiala Distributaries would be entitled to a constant supply of 400 cubic feet.</p> <p>But if the whole supply to the Branch fell to 400 cubic feet per second, it would be better to pass the whole 400 feet into the Patiala Distributaries for 4 days out of 12, closing them entirely on the remaining 8, than to allow them to run constantly with a supply of only 133 cubic feet per second.</p>
<p>In the event of a breach in the bank of a Patiala Distributary, or of sudden rainfall, or on any other emergency, the supply entering the Head shall on the requisition of a recognised or duly authorised State Official be instantly shut off, or reduced to the extent or within the limits that may be permissible under the rules in this regard that may from time to time be issued by the British Canal Officer.</p>	New	
<p>29. The British Canal Officer shall furnish the Patiala Agent, at intervals of not less than fourteen days, with a statement showing—</p> <p>the average daily supply entering the Sirsa Branch ;</p> <p>the average daily supply due to the Patiala Distributaries ;</p> <p>the average daily supply passed into the Patiala Distributaries ;</p> <p>the daily gauge readings at head of each Patiala Distributary, and the readings applied for by the Patiala Agent.</p>		
<p>30. Other matters connected with the management of the Canal and its connected works shall be settled by the Punjab</p>	27	

APPENDIX F-4.

		Sirhind Canal Agreement No.	Remarks by Superintending Engineer.																				
Government with the Patiala State, subject to the confirmation of the Supreme Government.																							
31. The Patiala State shall pay to the British Government an annual sum as seigniorage on the Jumna water supplied to Patiala territory at a rate which shall vary according to the estimated area of Patiala irrigation as follows :—		{ 15 } { 16 }	The introduction of a sliding scale for seigniorage is new, but will, I think, work more satisfactorily and fairly than provisos similar to those contained in Article 18 of the Sirhind Canal Agreement.																				
<table><tr><th colspan="2">ESTIMATED AREA IN ACRES.</th><th rowspan="2">Rate of seigniorage per acre.</th></tr><tr><th>Not less than</th><th>Below</th></tr><tr><td>...</td><td>42,000</td><td>Nil.</td></tr><tr><td>42,000</td><td>44,000</td><td>One anna.</td></tr><tr><td>44,000</td><td>46,000</td><td>Two annas.</td></tr><tr><td>46,000</td><td>48,000</td><td>Three annas.</td></tr><tr><td>48,000</td><td>...</td><td>Four annas.</td></tr></table>		ESTIMATED AREA IN ACRES.		Rate of seigniorage per acre.	Not less than	Below	...	42,000	Nil.	42,000	44,000	One anna.	44,000	46,000	Two annas.	46,000	48,000	Three annas.	48,000	...	Four annas.		
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46,000	48,000	Three annas.																					
48,000	...	Four annas.																					
32. The area on which seigniorage is to be paid annually will be estimated on the basis of the area actually irrigated during the year from the British Distributaries and the relative proportions of the supplies actually passed into the British and Patiala Distributaries during the same period, a deduction being made on account of the actual area of British territory irrigated from Patiala Distributaries, and an addition on account of the area of Patiala territory irrigated from British Distributaries.		17	The area liable to seigniorage must of course be the area potentially irrigated in Patiala territory, and not that potentially irrigated from Patiala Distributaries. The procedure laid down in this article will serve also to determine the estimated area of Patiala irrigation after the Distributaries have been finally made over to the State for the purposes of Article 19.																				
<p><i>Example.</i>—If the area irrigated on British Distributaries were 70,000 acres, and the supplies passed into the British and Patiala Distributaries averaged 700 and 300 cubic feet per second, respectively, the estimated area of irrigation of the Patiala Distributaries would be as follows :—</p> <p>$\frac{300}{700}$ of 70,000 = 30,000 acres.</p> <p>But if 3,000 acres of Patiala territory were irrigated from the British Distributaries and 6,000 acres of British territory were irrigated from Patiala Distributaries, the estimated area of Patiala irrigation would be—</p> <p>$30,000 + 3,000 - 6,000 = 27,000$ acres, and the seigniorage to be paid would be 27,000 acres at four annas, equal to Rs. 6,750.</p>																							
33. The first payment of seigniorage will be demanded on the area irrigated during the year 1902-03; that is, on the area irrigated during the Kharif of 1902 and the Rabi of 1902-03.		{ 18 } { 19 }	Irrigation having been effected from a Patiala Distributary in Rabi 1891-92, it is possible to fix the precise date from which seigniorage will become due, which was stated very indefinitely in the Sirhind Canal Agreement. The provisos of Article 18 of the Sirhind Canal Agreement have been altogether omitted, as they are unnecessary under the sliding scale of seigniorage proposed in Article 31																				

APPENDIX F-4.

	Sirhind Canal Agreement No.	Remarks by Superintending Engineer.
<p>34. In the event of any falling off in the supply of water available for the Sirsa Branch, the actual supply available shall be shared with the Patiala State in the proportions fixed under this Agreement, and the Patiala State shall have no claim for compensation from the British Government on account of any such reduction of the supply.</p>	20	
<p>35. The Patiala State shall have no claim against the British Government if the full percentage of supply allotted to the Patiala Distributaries be not taken but a portion be allowed to pass on into the Third Section; neither shall the State be entitled to claim a remission of seigniorage on this account, as the charges for seigniorage will be based on the supplies actually passed into the Patiala Distributaries. Nor shall it have any claim against the British Government on account of water escaping unused from the Patiala Distributaries, because it is not required or used in Patiala territory; but should the British Government realize any income from such surplus or unused water, the Patiala State shall be entitled to claim a remission of seigniorage equal to one-eighth of the income so derived, provided that whenever the rate of seigniorage is less than four annas per acre the above rate of remission shall be reduced proportionately.</p>	22	<p>The concluding sentence of this Article is rather more precise than the corresponding sentence in Article 22 of the Sirhind Canal Agreement. The proportion of one-eighth is based on an assumed water-rate of Rs 2 per acre on escape irrigation; but it is conceivable that income might be realized in some other way than by irrigation or water-rates.</p>
<p>36. The Patiala State shall furnish the British Government with half-yearly statements, giving for each harvest such information regarding the area irrigated by, the income derived from, and the working expenses of, the Patiala Distributaries as may be required by the British Government in connection with the annual statistics of the Western Jumna Canal.</p> <p>Similarly, the British Government shall furnish the Patiala State with such half-yearly or annual statements relating to the working of the Western Jumna Canal as may be desired.</p>	New.	<p>This Article is not in the Sirhind Canal Agreement, but the States concerned have since agreed to furnish the statistics required by Government of India, and it appears advisable that the obligation should be recognized in this Agreement</p>
<p>37. Offences against Canal regulations shall be dealt with as follows :—</p> <p>If a native British subject commits an offence in the Patiala territory, and is apprehended in that territory, he will be tried by the officers of the Patiala State, but if he is not apprehended in that territory, the officers of the Patiala State may report the matter to the British Canal Officer, and that officer will then proceed as if the offence had been committed in British territory.</p>	28	

	Sirhind Canal Agreement No.	Remarks by Superintending Engineer.
<p>The same procedure will be followed, <i>mutatis mutandis</i>, in the case of offences committed in British territory by subjects of the Patiala State.</p>		
<p>38. The British Government reserves to itself the right of extending or altering the Sirsa Branch at any future time in any way it pleases, on the understanding that the share of the water first assigned to the Patiala State under this Agreement shall not be interfered with or diminished without its consent being first obtained. And the expenses of such extension or alteration will be distributed in proportion to the advantages expected to accrue from such action to either of the parties concerned under this Agreement.</p>	40	
<p>39. So long as the original construction of the Patiala Section and Distributaries shall be in progress, it shall be the duty of the officers in charge to pay due attention to any representation of His Highness the Mahārāja of Patiala or his officers, and to carry out their wishes, as far as may be practicable or advisable.</p>	41	
<p>40. In case of any difference of opinion arising between the officers of the Patiala State and the British Canal Officers on any matter relating to the management of the Sirsa Branch Canal and its Distributaries, it shall be referred to the Lieutenant-Governor of the Punjab, whose decision shall be final. If any difference of opinion shall arise between the Patiala State and the Lieutenant-Governor of the Punjab as to the construction of this Agreement, a reference may be made to the Governor-General in Council, whose decision shall be final.</p>	43	
<p>41. It shall at any time be competent for the British Government to resume the entire management of the Patiala Distributaries, or of the irrigation in Patiala territory, if it shall consider that that State has not properly fulfilled the obligations which attach to the discharge of the duties which will devolve on it under the arrangement detailed above.</p>	44	
<p>42. These obligations may be summed up as follows:—</p> <p>1st.—Complete regularity in the payment of the salaries of all persons employed on the Canal, and in the provision of the funds necessary for carrying out the works which will be needed for its maintenance.</p> <p>If from any want of proper attention on the part of the Patiala State, the British Government is at any time forced to</p>	45	

APPENDIX F-4.

	Sirhind Canal Agreement No.	Remarks by Superintending Engineer.
<p>advance money for the due performance of works, or payment of salaries, &c., which will properly fall on that State under these arrangements, then the British Government must be understood to have the right to take complete charge of the whole administration of the Canal channels and irrigation connected with the Sirsa Branch which pertain to the State, and to retain them under its own officers until the evil complained of be corrected and matters be placed on a sound footing. But in such case, out of the income from the Canal, after deducting expenses, any surplus which may accrue shall be made over to the State.</p> <p>2nd.—Complete impartiality in the distribution of water from the Patiala Distributaries, so that British villages adjacent thereto shall, if required, share the water equally with the villages of the Patiala State, also an equal administration of justice to all persons over whom the officers of the Patiala State may exercise jurisdiction, so that the subjects of the British Government shall be dealt with according to the same principles of law as are respected by the officers of the British Government.</p> <p>3rd.—Ready and friendly compliance on the part of the Patiala State with those requests of the Punjab Government and its superior officers who have chief charge of the Irrigation Department in the Punjab which shall be declared by them to be essential for the proper maintenance and satisfactory working of the Sirsa Branch as a whole.</p> <p>The Governor-General in Council will at all times be ready to receive any representation from the Government of the Patiala State, if that Government considers that the spirit of the present proposals is from any cause not fully acted up to by the officers of the Punjab Government on whom the immediate duty of carrying them out will devolve.</p>		

Note.—The above Agreement was executed without alteration and approved and confirmed by the Governor-General on 29th August 1893. See Completion Report of Sirsa Branch, Western Jumna Canal, page 58.

Appendix K of the Completion Report, page 59, gives details of working of the Agreement.

The details of paragraphs 27 and 28 have been modified in 1925 (*vide* Chief Secretary to Government, Punjab's, letter No. 653-S. I., dated 2nd February 1925).

H. W. NICHOLSON.

